COMMON-SENSE HOMES

A PRACTICAL BOOK FOR EVERYBODY:

BY

SPENCER SILLS

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COMMON-SENSE HOMES

TYPE OF DEVON FIRE.

COMMON-SENSE HOMES

A PRACTICAL BOOK FOR EVERYBODY UPON THE ESSENTIAL EQUIPMENT AND TREATMENT OF THE HOME

By SPENCER SILLS

MEMBER OF THE SOCIETY OF ENGINEERS,
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WITH NUMEROUS ILLUSTRATIONS

CASSELL AND COMPANY, LIMITED
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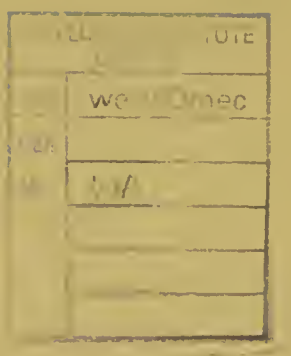

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COMMON-SENSE HOMES

Section I.—Structural

CHAPTER I

INTRODUCTORY AND GENERAL

"One may make the house a palace of sham, or he can make it a home."—MARK TWAIN.

SINCE those early days when Man, by reason of his physical weakness, sought rest and shelter in the trees or made himself a retreat within the recesses of the rocks, the home has become an integral part of our national and social life. But civilisation has bred in us a desire to make our place of dwelling something more than a mere shelter from the inclemency of the weather or an asylum from the molestation of our own species, and we have widened the significance of home immeasurably beyond the accepted definition of the word, which conveys no just appreciation of the many attributes that complete the sum of its charm and endearment.

So carefully are its portals guarded against the entrance of the undesirable that its sanctity has long been proverbial. Yet, with all our solicitude, the attack of disease frequently finds a weakness in the defences, and the insidious enemy enters into riotous possession.

"The home beautiful" has been the subject of prolific writing, and art has been administered to us in very liberal doses as the panacea for the dullness and discomfort which, in spite of modern improvements, seem to cling with singular persistency to many of our abodes. On the other hand, many very able men have laboured to promote a more rational mode of existence by enunciating the principles which govern health, and by explaining the laws of life and the dangers of their infraction.

But despite the enthusiastic acceptance by the energetic and eccentric of all and every new health doctrine which happens to be freshly revealed to them, the unheeding thousands persist in looking upon such matters as trivial. A deeply rooted aversion to fads leads most men to put such things aside as really too troublesome and preposterous, or they mentally

promise the question consideration at a future time, and promptly forget it. This is a peculiarity of human nature difficult to overcome, but it is responsible in a great measure for much which is avoidable.

A great deal of the disease with which we are afflicted, and much of the misery regarded as the inevitable heritage of mankind, are due to wilful neglect and gross ignorance, for which there is assuredly very little excuse. High and low, rich and poor, and even the sober middle class, show, as a rule, a serene disregard for simple facts and common-sense reasoning relative to matters which lie outside their own particular calling, the great majority being quite content to take things as they find them, without why or wherefore. "The future lies on the knees of the gods!" What need, then, to attempt to free ourselves from the bonds which fetter us to the habits of centuries, and the surviving practices of a savage ancestry? Our forefathers flourished in spite of their ignorance and squalor; but what of the pestilence and what of the plagues which until quite modern times were ever-recurring terrors?

The idleness and filthy habits of many of our poorer brethren, coupled with their destructive tendencies, impose a burden upon the house owner, in the nature of essential repairs, which precludes the possibility of desirable and necessary improvements, and the situation will present the same difficulties for all time, whatever may be accomplished in the way of provided dwellings, municipal or otherwise, unless some means can be adopted to bring home to this class the benefits of decent living.

The Socialist would tell us that the rights of private ownership, which hedge us in on every side, are responsible for much that is wrong in this respect; and many of us are quite willing to sit down and wait for the coming of those Utopian days which he tells us are at hand. But meantime, if such days are to come, can we not at least make an effort to lessen the instant evils by present action, and by so doing be the better prepared to appreciate fully that golden millennium when it dawns?

Each year the holiday season sees the migration of great numbers from our cities and towns in search of health and relaxation. Seaside and countryside resorts are thronged with humanity, crowded into lodging-houses and hived in hotels, living, in many cases, under conditions which in ordinary circumstances would be regarded as insupportable. The resultant benefit of such a holiday would often be a minus quantity were it not for the entire change of scene and society and the temporary relaxation from the tension of business life, the fresh air and healthy surroundings being often more imaginary than real.

Then, too, we have the week-end habit, which of late years has impelled

great numbers to get away from business cares into the quiet of the country at any cost and inconvenience. This has led to the transformation of the labourer's cottage into the "bijou residence" for more affluent occupancy, and the erection of innumerable bungalows, artistic and otherwise, in all sorts of sequestered spots and out-of-the-way nooks. The transformed cottage bears no trace of its one-time squalor; but, brave in its veneer of gentility, makes an alluring picture for the beguiling of the unwary. Under the glossy paint and showy plaster may still lurk the defects which but a few months before made this self-same abode, from a health point of view, an unfit habitation for the farm hand. From beneath its floors the thin, unwholesome vapours of earth may arise, as aforetime, to permeate the whole house. The walls have still no provision against rising damp, and are covered internally with ancient plaster tainted with the accumulated impurities of generations of sickly tenants. An archaic system for the disposal of waste still exists, although probably thinly disguised, and in the midst still stands the *delightful* (?) drinking-well, in all its charming simplicity! The situation altogether has perhaps but one redeeming feature—the picturesque.

Much the same may be said of the bungalow, and the tenant of such is fortunate if the compensating influences of unlimited fresh air and out-door exercise happen to counterbalance the effect of the untoward conditions. Cheap construction is frequently uneconomical, and the path of the amateur architect is strewn with pitfalls and lined with ambuscades planted by the man with something to sell. Indeed, it may be safely asserted that in the majority of instances little or nothing is gained from such experiences except the whimsical gratification of a hobby. Technical guidance in such matters as this is absolutely necessary. With some knowledge upon essential points, and a modicum of common sense, a start on a sound basis would be possible and a real chance of ultimate benefit to health assured.

The man who pins his faith to the primitive methods of an early civilisation loses sight of the fact that the country is now more crowded, and the human organisation more susceptible to disease by reason of its finer development and the greater demands made upon it in the more strenuous life we lead.

Zymotic diseases are due to the propagation and spreading of germs of such microscopic proportions that the finest dust may contain them in great abundance. The essential elements which support life may be, and in all probability often are, contaminated with them, and the poison is taken freely into the body with the air we breathe, in liquids we drink, and in the food we eat. Our inability to avoid these tiny assailants is counter-

balanced by natural provisions which enable the body to resist their attacks, provided the vital energies are not weakened by unnatural conditions of living, or that the growth of the disease has not assumed too great a virulence. Cleanliness and safety are as inseparable as dust and danger, and it is only the general recognition of this fact which will give us a greater freedom from the outbreaks which now so frequently disturb us.

There are always to be found numbers of people ever ready to decry the present times, especially with regard to building. Generally, those who know least about the matter are the most vociferous in the outcry at the decadency of the builder.

We are often told how much better things were done in the "good old days," although, as a fact, our informants have but a misty idea of the precise period to which they would refer us for examples. Apparently, the notion is "The older the days the better the building." Such is the inference drawn from the observations of those who compare modern domestic building with the massive construction of a Norman keep, built to withstand the shocks of war. Or it may be some surviving Elizabethan building, the remains of a semi-fortified country house, or the former abode of a merchant prince—the massive detail of which they are so inclined to contrast with the constructive features of the tiny suburban villa of the present day.

Surely a very little reasoning would suggest that the survival of the solitary example is due largely to special and costly work; the wealth of carving, the enriched plaster, the wainscoted walls, and a thousand details of ornament and construction, stamp the building as a place of one-time importance. The crazy farm-house, with its unceiled rooms and tottering walls, the almost unlighted labourer's cottage, and the dilapidated slum dwellings, are often contemporaries of these much admired structures, but the poorer buildings escape admiring notice. Good sound building can be, and is, obtained, even in these degenerate days, upon exactly the same conditions as when these admirable models were constructed, viz. by paying the price for good work.

At no time in the world's history has there been a greater craze for cheap construction.

The architect is often cramped and restricted by the misconceptions of his client, in whose mind ostentation and parsimony are at variance. The builder is bound down by rigorous conditions and nailed to the smallest possible figure, the job being let in a species of Dutch auction to the lowest bidder.

Can excellency of workmanship be ensured, or even expected, in such circumstances ? Again, in the matter of repairs the work is not infrequently entrusted to the ill-trained and ignorant handyman in preference to the skilled workman, because the former is thought to be cheaper.

This is the alphabet of jerry-building, and until common-sense reasoning displaces this cheeseparing economy better work cannot be expected, and the public health will continue to suffer as a consequence.

Aversion to light and air would appear to be characteristic of the British housewife, to judge from the external appearances of many of our dwellings. Not only is this remarkable with regard to the poorer neighbourhoods, but may be noted throughout Suburbia and among the best class of residential property. On a genial spring morning or, for that matter, in really warm weather, one may pass from end to end of many a street and observe nearly every window tightly closed, or, at the best, opened a meagre inch or two—usually at the bottom. The blinds are carefully drawn down so as to screen at least one-third of the window, and on the sunny side of the thoroughfare it is customary to veil the window entirely, to avoid the destructive bleaching effects of the sun's rays upon wall-papers, carpets, and furniture. Other reasons sufficiently sane as an excuse for the custom are no doubt forthcoming, and the housewife cannot be persuaded that there is much to be gained by the wholesome admission of light and air at all times, even at the risk of the entry of dust and fading of carpets. Better this than the rigorous exclusion of these envoys of health for fear of such minor evils.

The microscopic organisms of disease are spread with such facility, and their growth is so rapid, that whole communities may be affected before the presence of disease is suspected.

The agency of the common house-fly in sowing disease broadcast has long been a known fact, but it is difficult to impress this sufficiently upon the public mind. The foot of the fly is provided with a gummy substance which enables it to walk upon smooth and inverted surfaces, and to this substance the minute germs of disease may cling in thousands, to be transferred to any food or liquid that may be exposed to its visits. The Medical Officer of Health for Woolwich, in a recent report, refers to the infant mortality in his district due to " zymotic enteritis," which recurs during each summer and early autumn, the spread of which he ascribes to flies.

Disease is also spread by exudations from the trunk or proboscis of the fly, bites from the flea, gnat, mosquito, etc. Bubonic plague, which devastated London and many other towns in 1665, and has of recent years

been particularly troublesome in India, owes its virulence in a great measure to the rat flea.

Since the accumulation of garbage and lumber, and general uncleanliness in and about the house, encourages and breeds such pests, the need for greater exertion in attending to such matters cannot be too strongly advocated, nor the Gospel of Cleanliness too often preached. As a recent writer in a London daily paper says, "The national well-being depends very much upon the standard of comfort in the home," and an efficient standard cannot be maintained when the laws of health and reason are ignored.

CHAPTER II

THE HOUSE AND ITS SITUATION

"Few have wealth, but all must have a home."—EMERSON.

FEW problems in life are more difficult of solution than the ever recurring question of where to live. To most of us locality and situation are to some extent a matter of choice, even with regard to quite small houses. On the other hand, there are many people who are compelled by business demands to accept what a certain neighbourhood has to offer, or who are tied still more closely by paramount considerations to one particular spot. Cheap and rapid transit affords a wider range to thousands, and there is still a multitude to whom such facilities are not necessarily a matter of importance. But the privilege of a choice is in some measure open to the very great majority.

Decision is oft-times governed by matters of really minor importance, such as external appearances, surroundings, etc., and subsequent experience may awake vague doubts as to the wisdom of the choice, inciting a feeling of helplessness and unrest, which is by no means lessened by a recognised limited knowledge of structural affairs.

In such circumstances a few practical hints, carefully studied, would enable a choice to be made with more certainty of permanent satisfaction, and establish in the mind a feeling of content which would go far towards obviating much of the needless trouble and expense of frequent movings; and would, moreover, dispel very many imaginary objections which attach themselves to really desirable dwellings. The choice of situation with regard to soil is naturally more limited than that of locality, although in hilly districts the difference of a few yards may be of the greatest importance in this respect.

Aspect, when one is compelled to reside in or on the immediate borders of a town, is a factor which we are often forced to ignore in the face of other advantages. Then, too, roads and streets are not often laid out with any such object in view, but purely on lines of the economic parcelling out of the land.

Prospect is usually a great allurement, and a pleasant outlook will

frequently settle the choice off-hand when probably the house has otherwise a number of distinct imperfections and disadvantages.

Soil. A situation upon a sandy or gravel soil is to be preferred, provided that the soil is sufficiently deep and the site of such an altitude that it is naturally free from water. Directly opposed to this, or a bad situation, is a low-lying site upon clay soil, where the conditions alternate between extreme aridness in summer and a sloppy, waterlogged state during the greater part of spring, autumn, and winter. The higher slopes of valleys are therefore to be preferred to the lower levels.

Aspect. The desirability of an open situation depends largely upon the aspect, but in any circumstances it is likely to prove generally more healthy and comfortable than a site thickly and immediately surrounded by large forest trees. Consider the aspect and choose, if possible, one which admits of free access of sunshine into the house in preference to a pleasing prospect or a charming situation, however invitingly placed. A south-east aspect is the best, being exposed only to the mildest winds and possessing the very great advantage of a full exposure to the morning sunlight. Due south is not so good, being more sultry, and south-west is exposed to boisterous gales in autumn and winter and to sultry heat in summer. From south-west to west and from west to north is increasingly rough and wet. South-east to east is colder, and the farther we get towards north the more prevalent are cold winds and the greater the exposure to frost and snow.

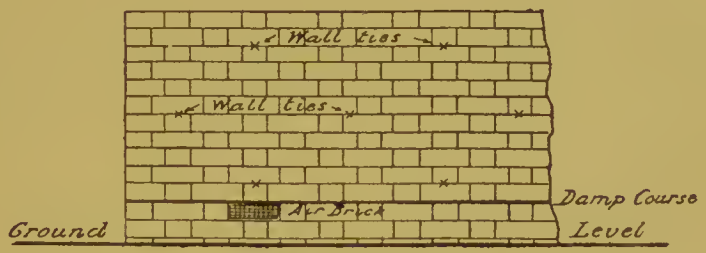
Trees and Shrubs. The close proximity to the house of large trees may have a pleasing effect when viewed externally, but they are likely to make the house dark and damp by the exclusion of sunlight and air. True, they may afford in some situations an amount of shelter from boisterous winds, but the effects of these are better endured than the perpetual gloom pervading the dwelling owing to the interception of so much light.

Similar objections hold good with regard to shrubberies, which are usually planted too profusely and too close to the house. Indeed, upon this point we would be more emphatic. In order to secure privacy it is not necessary to exclude light. Shrubs are generally as badly chosen as they are situated, and much too thickly planted. Variety should be studied in relation to space quite as carefully as quantity, and when planting error should be on the side of sparsity. Dwarf varieties and slow-growing shrubs should be chosen for confined spaces, and more vigorous and taller growths allotted to open situations away from the house.

The existence of flower borders close up to the house is responsible for a great deal of dampness in the walls by reason of the quantity

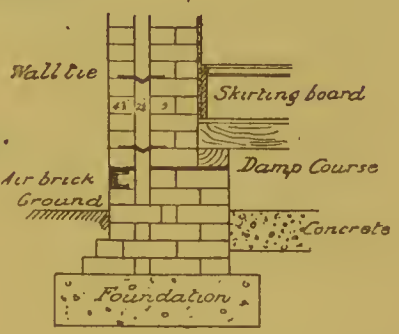
Structural Details

Means employed to ensure Dry Dwellings.



Elevation

Hollow Walls, Damp Course and Ventilation beneath Floors.



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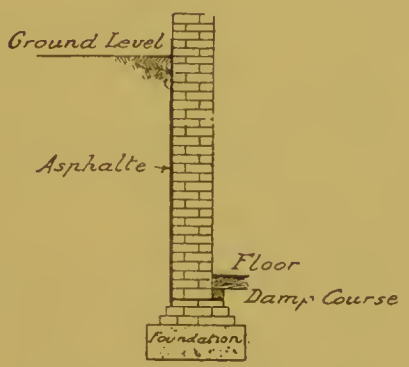
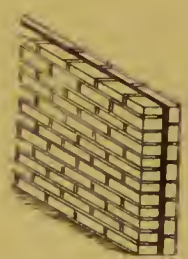


Asphalte lining at back of basement wall



Hollow wall with space filled with asphalte or pitch

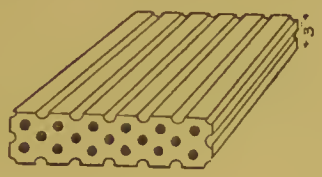
of moisture absorbed by the open ground, particularly in comparatively sunless situations. If a fairly wide, well-rolled gravel path is made with a slope outward from the house in place of the border, the danger of damp walls is greatly minimised.

Creepers. The picturesque ivy or graceful creeper may not be the direct cause of dampness until they get out of hand, but such growths require constant attention to keep them within bounds, as they have a tendency to creep into and choke eaves gutters, to upset rain-water pipes, and to lift the slates or tiles at the eaves. Besides this, much damage is ultimately occasioned by the rootlets thrown out by the stems, which feed on the mortar joints. Varieties which cling with sucker-like tendrils to the walls will in time work considerable damage to the face of brick- or stone-work. Creepers also form convenient ladders for the invasion of the upper rooms by insects of various kinds, in addition to encouraging the establishment of colonies of the destructive house-sparrow. At any rate, the tendency to run riot and overgrow windows or other apertures intended for the admission of light or air to the house should be severely checked.

Position of House. The house should occupy the higher ground of its enclosure, where possible, so that the rains have a natural tendency to drain away from the building. When such an arrangement is impracticable, suitable provision should be made to carry the water away from the site, by covering with some impervious paving materials a sufficiently wide area of ground along the upper side of the house. The rain falling upon the open ground may thus be prevented, in a great measure, from draining to the house walls, particularly if the soil be fairly deep and absorbent. It may also be found advisable to tar-pave or concrete a wide pathway close to and along the flank sides of the house where exposed to a wet quarter, especially if the space gets little sunshine. In some situations a systematic drainage of the subsoil is necessary before the site is built upon.

Damp Course. Too much emphasis cannot be laid upon the dangers of a chronically damp house, for a damp abode is usually cold and comfortless, and in addition to the increased expense of warming in winter there are grave risks to be encountered from various diseases which are generally judged to be the product of cold and damp.

Provision against rising damp is made in modern buildings by the application of a damp course or impervious stratum at the base of every wall at least 6 inches above the ground level and 6 to 9 inches below the surface of the ground floor. This is formed with slates bedded in cement, mineral asphalt, lead, glazed bricks, or other imperishable material

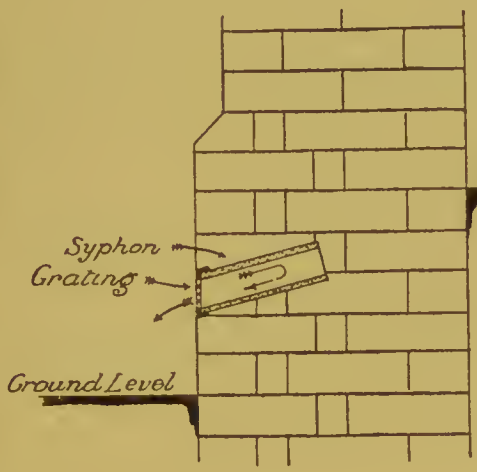


VITREOUS
DAMP COURSE
AND VENTILATING BRICK

Clay

Iron

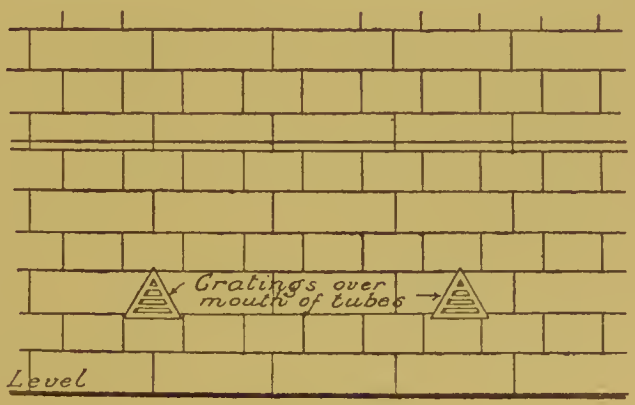
AIR BRICKS



THE "K" SYSTEM
OF DRYING
DAMP WALLS

Floor Level

SECTION



ELEVATION

unaffected by damp, and prevents the upward creeping of moisture due to capillary attraction, which would otherwise take place within the walls.

Beneath every floor on the ground level or in the basement there should be a layer of cement concrete covering the whole area of the site from wall to wall, with a view to preventing the rising of earthy vapours and exhalations of ground air into the house.

Ventilation under Floors. The space between the paving and the floor above should be well ventilated by air-bricks placed in the outer walls and so arranged that a perfectly free through passage of air from one side of the house to the other, beneath the floors, is ensured. The object of this ventilation is the prevention of dry rot, which speedily attacks timbers exposed to stagnated air. It is therefore essential that these air-bricks or gratings should be kept free from creepers or any other obstructions which may prevent or impede the flow of air; and if broken they should be immediately repaired, otherwise rats or mice may establish themselves beneath the floors. Floors of wood blocks, tiling, etc., do not, of course, need such space beneath them, and are laid directly upon a bed of concrete.

Damp Walls. Signs of rising damp in the walls, or from beneath the floors, may be readily traced where no such precautions as described above have been observed. These may be read in the discoloration of the wall-paper or the bleaching out of the pattern extending from the floor upwards; loose and crumbling plaster; discoloured or decayed skirting-boards; and blackened, damp, or rotten flooring. The results of such defects may be in some degree obliterated by recent repairs and renovations; but intelligent observation will detect renewals to floors or skirtings, and if the wall-paper shows a recently added dado while the upper portion is still fresh and clean, or the paper betrays a reluctance to cling to the walls, closer inquiry is advisable.

Structural Defects. Dampness at higher levels should be looked for, as moisture may find an entrance at many points where structural defects exist, such as decayed or damaged window-sills; choked, defective, or broken eaves gutters; cracked or choked rain-water down pipes; constantly dripping cistern overflows; decayed brickwork; faulty chimney-stacks; or damaged roofs.

Cellar. The cellar should receive special attention, situated, as it usually is, under a room or rooms much used by the family. A damp cellar will make a damp house, and the welly atmosphere which will rise and circulate through the building renders it anything but a desirable abode. The cellar floor should be made impervious to rising damp, by being paved with concrete, or bricks upon a concrete bed. The walls

should be dry, and there should be ample provision for a free circulation of air through the apartment. The place should be moderately well lighted from without, and if windows are arranged in sunk areas there should be means provided for draining off the rain-water falling therein.

Damp Basement Walls. Damp cellar or basement walls may be improved by a coating of silicate paint or one of the so-called petrifying liquids applied during the driest period of the year ; but this is purely a palliative, and a cure is only to be attained by treating the outside of the wall by digging away the earth and coating the wall externally with asphalt and inserting a damp course, or by building a 4½ inches thick wall outside, leaving a cavity 1½ inches to 2 inches wide between this and the old wall, the cavity being kept clear of mortar droppings and finally filled up to above ground level with hot coal-tar pitch.

Another method is to make a cavity 2½ inches wide between the walls and bond into the old work with iron ties, covering the top of cavity and new wall with a weathering of stone or tiles, and ventilating the space by air-bricks top and bottom, inserted through the old wall from the cellar.

If, for reasons, the difficulty may not be attacked from the outside, an inner lining to the wall, with a cavity between this and the old work, will be as effectual if properly ventilated and if loss of space is no object. Internal lining with wood battens and match-lining is not to be relied upon, as the moisture behind the woodwork sets up rapid decay and fungous growths.

The " K " system of drying walls consists of a simple device whereby tubes of a porous material are inserted in an inclined position through half the thickness of the wall, about 2 feet apart, and in one or more rows. These tubes are said to abstract the moisture from the wall by setting up a syphonic circulation of air, which discharges the water in the form of vapour through the small grating masking the mouth of each tube.

CHAPTER III

THE HOUSE AND ITS ACCOMMODATION

"Full of great rooms and small
. . . an English home, all things in order stored."

TENNYSON.

THE accommodation of a modern house may be roughly classified under the following heads: Bedrooms, reception or living-rooms, kitchen, and offices. The first division comprises the bedrooms proper, night and day nurseries, dressing-rooms, etc. Under the second is included dining-rooms, sitting-room, study or library, drawing-room, morning-room, breakfast-room, parlour, etc. The third includes kitchen, scullery, pantries, larder, bath-room, cellar, w.c.'s, lavatories, stables, etc., etc.

Bedrooms. The construction and arrangement of bedrooms is most important, for it is within these apartments, as a rule, that the greater time spent within doors is passed. During sleep our vitality is lower, and we are more susceptible to the ill effects of injurious exhalations and gases, hence the necessity of an airy and spacious sleeping apartment is imperative. No bedroom should be without a properly constructed open fireplace, and it must be remembered that such fireplaces serve their most useful purpose as ventilators. The registers of the stoves must be kept open, and one should not be tempted to use a chimney-board from fear of down draught or aversion to an untidy hearth.

The primary use of a bedroom is the accommodation of a bed, and for this there should be ample space without placing it close to the window or to the fireplace. Many rooms are so badly designed that such a feat is impossible.

The window or windows should be as large as possible, within the bounds of reason, and carried up to within a few inches of the ceiling. They should also be constructed to open top and bottom to the fullest possible extent.

The door should be placed near to one corner of the room, and as far from the window as possible, and hung so that it screens the bed and the greater part of the room upon entering. This is most desirable, in order that privacy may be ensured and a direct draught on to the bed avoided.

The furnishing of a bedroom should be as light as possible compatible with convenience and comfort. Thick and heavy carpetings are better avoided, and the practice of covering the entire floor with such material should certainly be discountenanced. If the floor is completely covered with carefully laid linoleum, and light rugs or mats are placed in suitable positions, so that the bare feet need not come in contact with its cold surface, we get a floor surface which does not collect and retain dirt and dust, and which is easily and quickly cleaned.

Make the window hangings as scanty as practicable to allow of the admission of the maximum amount of light, and eschew all unnecessary bed curtains, hangings or valences, which will collect dust or harbour insects.

The bedroom, above all other rooms, should be restful; therefore, papers of a striking or pronounced and intricate pattern should not be chosen for its walls, but the choice confined to soft shades of blue, green, or pink, with quiet, unobtrusive designs. The popular term "cosy" carries with it so much that is connected with heavy draperies and superfluous furniture that its employment in relation to the bedroom does not suggest the desirable. Generally speaking, the English bedroom is far too crowded and stuffy to afford that degree of complete repose which is needed by the body and mind during the hours of resting, and a substantial advantage would be realised by the total abandonment of the cosy apartment for a chamber of more ascetic character, wherein there is little but the bare necessities for repose and the toilet.

Dirty linen should certainly not be stored in the bedroom, but a proper receptacle provided for it in the bath-room, in a corner of a landing, or some equally well-ventilated situation.

Reception Rooms.

The reception-rooms are those to which the architect and the builder devote the greatest amount of consideration in design and construction; consequently they are, as a rule, by far the best lighted and arranged.

Modern building by-laws require a height or pitch of at least 8 feet for every habitable room, and this can be with advantage increased to 10 or 12 feet, according to the class of property and the dimensions of the apartment. A minimum area for windows lighting such rooms is also prescribed, which usually amounts to one-tenth of the floor area, and this also may be beneficially increased, as efficiency of such lighting is often impaired by the proximity of tall buildings and trees or the unfortunate placing of the window.

The cheerful character of a room is largely dependent upon its out-

look, and if the window opens on to a narrow court or passage, a tiny yard or small enclosure, the apartment appears to be afflicted with a lasting dullness and depression. Robbed of its sunshine, and obtaining but a poor supply of really fresh air, it is dominated entirely by the mean externals.

The custom of decorating the window with vivaria, or similar expediences, to shut out the unpleasing view, only tends to render the room more gloomy by the exclusion of light. The only reasonable palliative is the reformation or improvement of the outlook by enlarging the view, or stocking the enclosure with plants of judicious selection.

The obvious necessity for bright and cheerful surroundings should lead to the selection of the pleasantest room for that in which the greater part of the family life is spent, and the relegation of the least cheerful apartment to those uses which are occasional. The truth of this is not generally recognised, and in the smaller houses we invariably find the brightest room set apart as that house-proud anomaly, "the best room," in which the family seldom congregates. In its carefully veiled windows and stuffy atmosphere it has the air and appearance of a mausoleum devoted to the preservation of family relics, the precincts of which are not to be too lightly invaded.

Papers. The decoration of the walls is an important feature, to which very little careful attention is paid, in relation to the character or use of a room. The very general use of wall-papers has placed upon the market such a variety in colour and design, that the most fastidious taste is easily gratified. The difficulty, however, often lies in the total absence of taste, or the inability to discriminate, or to realise the application of a certain shade or pattern until the familiarity of every-day acquaintance has brought out its faults or virtues. In the knowledge of what to avoid lies the secret of what to choose.

It is manifest that bold designs and gaudy colourings are suitable only for very large and richly appointed rooms. Pronounced shades of red are said to produce irritability, and decided yellows to incite a tendency to melancholy. These should, therefore, only be employed in rooms of occasional use, or, better still, altogether avoided.

Blues and greens of the paler shades are restful; shades of pale pink and amber are bright and cheerful; blue greys are soft and comfortable; while browns, unless of a decidedly warm tone, are inclined to dinginess. Venetian or terra-cotta reds may be used for entrance halls or dining-rooms: shades of green, blue, or grey for retiring-rooms, and shades of pink, amber, and blue greys for morning-rooms. Much, how-

ever, depends upon the aspect and outlook of the rooms, a north aspect requiring brighter and warmer tints than a south aspect, which may with great advantage be treated with the coldest shades. A badly lighted room needs a light and cheerful paper, and the influence of a dreary outlook upon a room may be counterbalanced to a very great extent by the choice of tints suggesting light and freshness.

Passages, etc. For corridors, passages, staircases, and landings there is a great variety of special designs, many of which may be sized and varnished, so that frequent cleaning or wiping down to remove dust is possible. Usually it will be found advisable to choose somewhat light shades for staircases and passages, particularly if such places are narrow or badly lighted.

The fear of arsenical poisoning will lead to the utter rejection of all shades of or any approach to green by many careful people. But this danger is common to papers of most colours of certain makes and even some white paper. Compounds of copper and mercury are also present in objectionable quantities in others. This difficulty may be surmounted by the use of good papers, which can be obtained guaranteed free from such metals, or by choosing the so-called "sanitary" papers supplied by reputable firms. Of the latter it is certainly said in their disfavour that the colours are more fleeting than those of the less innocent makes; but even this is an advantage, as it ensures at least a more frequent re-papering, which is decidedly necessary in many homes.

The absorbent powers of the ordinary wall are very great. Exhalations and emanations from the body are carried thither by air currents, and adhere to the surface or are absorbed, and, as air actually passes through the plaster, the paper acts as a species of filter—collecting and retaining a great quantity of decayed and decaying organic matter. Thoroughness in the operation of re-papering should not, therefore, be overlooked, and every scrap of old wall covering must be removed and burnt, and the wall should be rubbed down and washed with a weak solution of carbolic acid before a fresh paper is applied.

Offices. The offices comprise the whole of the administrative portion of the house, or that part of the establishment devoted to the task of ministering to the needs and comfort of the family, such as the preparation of food, and the carrying out of various household works and duties essential to the family life; the apartments which contain the fittings for ablution, and the disposal of wastes; the accommodation for stores, etc.

Kitchen. The kitchen, with its necessary appurtenance, the scullery, is often the worst planned part of the house: in many instances poorly lighted, badly situated, and of insufficient size. Very little reflection is needed to convince us that the neglect of this department is a grave mistake, particularly in view of the fact that confined space and poor accommodation are conducive to careless practices, uncleanly habits, and waste. We have only to recall the appearance presented to us when we have sometimes unexpectedly visited such departments, to conclude that the kitchen is generally the worst ordered portion of the whole establishment. This is not altogether the outcome of insufficient supervision, or the carelessness of servants, but is, for the most part, due to faults of accommodation and fitting.

Ample light is most necessary, and the number and disposition of the windows should be such that all parts of the room are well illuminated.

The kitchen floor is usually a source of trouble, abounding in cracks and crevices in which the chirping cricket and noisome cockroach quickly establish themselves if care is not exercised in detecting their early appearance and dealing with the matter promptly; and the open space beneath the floor provides a possible home for mice or the more iniquitous rat. Although such domestic terrors have troubled us for centuries, we are very slow to adopt means to prevent the possibility of such invasions altogether. To this end an improvement of the floor is obviously needed, and no better method suggests itself than that of laying a floor of good concrete 4 inches thick, and nailing upon this rebated deal flooring of good quality, 1 inch thick, in narrow widths. The under side of the floor boards should be tarred before laying, or they may be laid directly upon a ½-inch thick layer of bituminous asphalt, spread over the concrete. Wedge-shaped fillets, or wood strips, are embedded in the concrete to form fixings, to which the boards are nailed. The floor may be made more complete by leaving a 6-inch wide margin all round the walls, to be finished with fine cement concrete, floated to a smooth surface, level with the floor, and carried 9 inches up the wall as a skirting, with coved or hollow rounded angles to prevent collection of dust. Such a floor is noiseless, warm, and, if well laid, particularly free from cracks or open joints, and might be advantageously employed in all rooms on the ground floor.

The margins and skirtings may be finished with "Newoleum," "Marbolith," or "Dolomen t," or, if desired, the whole floor may be laid with the latter material, which has a perfectly non-absorbent surface and forms a solid, jointless flooring, and is said to be warm. This can be laid upon concrete, and is warranted not to shrink or crack.

It is not always possible, however, to deal with this question as we would desire, so we have perforce to do the best we can with the existing construction. This is to be accomplished by the accurate and careful covering of the entire floor with good stout linoleum.

Kitchen Walls. Papered walls in a kitchen are open to objection on account of their ready absorption of moisture arising from cooking operations, and the facility with which they collect dust and dirt. An oil-painted or varnished surface appears to be the desideratum, and if the whole of the wall surface is thus treated, from floor to ceiling, with good oil colour or washable distemper and varnished, the hygienic conditions will be distinctly improved. Ugliness need not result from such a procedure, for any desirable shades may be employed, in frieze, body, and dado, and a pleasing effect obtained. Initial cost should not be an insuperable difficulty, as such a treatment will give many years of service with ordinary care and an occasional coat of varnish. In large establishments, where the kitchen is used solely for the preparation of food, and does not represent also the sitting-room of the maids, the walls may be either dadoed or completely covered with glazed tiling.

Cupboards. Cupboard accommodation is a necessity which is very frequently stinted within the kitchen itself, at the expense of much time and material and to the encouragement of carelessness and disorder. Ample cupboard room for necessary storage should be provided. It would be preferable to keep all such cupboards at least 18 inches off the floor, so that the linoleum may be laid over the entire floor, and the formation of likely hiding-places for beetles or hollows for the collection of dust avoided. The upper part of the dresser might be hung to the wall, and the lower or cupboard portion made as a separate and movable fitting or supported upon wall brackets, with the same object in view. Accommodation should also be provided elsewhere than in the kitchen for the maids' cloaks and hats, for emergency use.

The scullery, as befitting the rough nature of the work for which it is intended, should have a concrete or tile-paved floor, distempered, oil-painted, or tiled walls, in accordance with the possibilities of the case. Good light is most requisite, and suitable accommodation for the disposal of wastes; also the provision of suitable water fittings.

The Bath-room. The household bath is a necessity rather than a luxury, and year by year the fact becomes more impressed upon us, as the increasing strain upon the human organisation demands greater care and more attention to physical requirements, and

very few houses are now erected which do not provide this essential sanitary item.

The bath, in common with all sanitary fittings, should be placed in a well-lighted and ventilated space, and should on no account be rammed into any odd corner where ventilation may be difficult, light scarce, or comfort in its use impossible. It is imperative that the bath-room should have at least one external wall into which a window of very ample proportions should be inserted, and in addition to this window, which should be made to open fully, the room should be provided with ample inlet and outlet ventilators, so that the room is at all times comfortably aired.

The combined use of one small room for the accommodation of bath and water-closet is neither a convenient nor a comfortable arrangement, and effects but a small saving of space. With a little contrivance a separate inclosure may be given to both fittings, without outraging economy.

Bath in Kitchen.

Where space is limited, as in small houses, the bath is sometimes placed in the kitchen or scullery, either in such a position that, covered with a wooden top, it may serve as a bench at ordinary times, or else it is sunk in the floor and provided with a suitable cover. Its situation in the kitchen is to be avoided if practicable, as the presence of such appliances in a room where food is frequently exposed is objectionable. The position in the floor is not a good one, as there is difficulty in keeping the cover in safe repair, and constant accumulations of dirt and grit filter through the joints of the cover and often choke the outlet, to say nothing of the addition to the maternal difficulties when bathing children.

Folding Baths.

The bath difficulty is often a poser, and various are the ingenious contrivances to solve the problem. One of the most noteworthy is the folding-bath, so constructed that when out of use it can be swung up on the hinged end into a recess or cupboard, and hidden from view by a curtain or door. This is an excellent idea, but precaution should be taken to ensure a thorough ventilation of the cupboard or recess into the outer air, otherwise unpleasant smells may arise.

Bath-room Floor and Walls.

The floor surface of the bath-room should, of course, be impervious to moisture, and where a tiled floor is impracticable the floor may be laid with "Doloment," "Newoleum," "Marbolith," or similar jointless flooring, which can be placed upon the ordinary wood floor; or the floor should be covered with well fitted and jointed linoleum, securely fastened down.

Cork mats, China matting, or wood gratings, which should be dried and aired after use, are necessary for comfort.

Tiled walls are to be preferred to any other treatment of these surfaces where practicable, and glass tiling is now used for this purpose. These glass tiles are made in various colours, marbled, or in etched designs, and are said to be durable and easily kept clean. The best known makes are "Modernia," "Newellite," and "Opalite."

Where cost has to be considered, a less expensive material is found in "Emdeca," an enamelled zinc decoration, which claims to be wear-resisting and serviceable. Failing the employment of either of the foregoing on account of expense, the walls should be oil-painted and varnished, or at least treated with a washable distemper and varnished so that they may be frequently cleaned down.

Water-closets.

The situation of the w.c. is a matter of the utmost importance, and is not to be too casually arranged. Such fittings in the older houses were placed in any hole or corner, out of the way and out of sight. Cupboard-like arrangements were situated under stairs, in dark corners, on landings, or at the end of dim passages, and even in the cellar; no matter how inconvenient or obscure the position—the one aim apparently was to hide an unpleasant contrivance, the existence of which it was not polite to acknowledge.

Happily, the present age knows less of such foolish prudery, or broader views have been forced upon us by the harsh teaching of experience, and such arrangements, with due regard to decency, are now somewhat prominent features in a modern house. The unfortunate position of a w.c., even when the most modern requirements are observed, may be a bar to the comfort of the entire household, as, for example, when situated in a part of the house opposed to prevailing winds, or when the window, intended for ventilation, looks out into a well-hole or narrow cul-de-sac passage or court, subject to eddying winds. In such cases the only alternative to an expensive and problematic system of exhaust ventilation is the removal of the entire convenience to another situation.

The w.c. apartment must have one external wall in which a window, made to open fully and certainly not less than 2 or 3 superficial feet in area, should be placed, and through this wall the soil pipe is to be carried out.

When a w.c. apartment or a bath-room is built out as an annexe to the house, the difficulties of efficient ventilation are very much lessened, and a good through current of air removes all possible chance of unpleasantness from the former convenience.

The situation of a w.c. in a basement area is certainly to be avoided,

or, indeed, any position which does not admit of perfectly free access of light and circulation of air. A thorough ventilation of the w.c. apartment may be ensured, to some extent, by the insertion of air bricks, or an inlet tube just above the floor line, and by making it a rule to leave the window open. Jointless flooring—such as previously mentioned—of tiling or concrete is to be preferred, and a dado of tiles to the walls is advisable, but where such ideal conditions are not permissible the floor may be covered with stout linoleum completely, and the walls oil-painted or distempered.

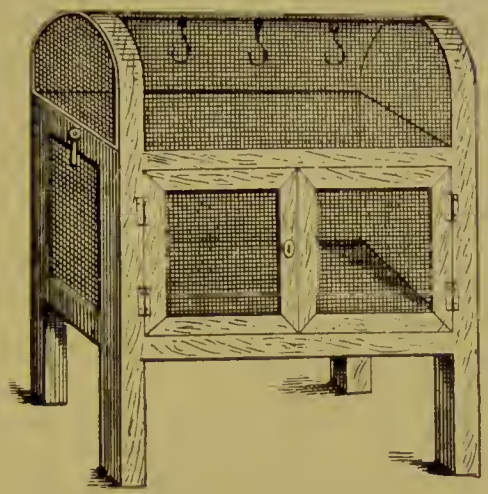
Storage. The accommodation for storage is not infrequently limited to the odds and ends of space which cannot be advantageously used for any other purpose, and, so far as this relates to commodities other than food, the arrangement may be as convenient as it is economical; but common practice makes very little distinction, and what is good enough for one thing is considered amply sufficient for another, provided that the accommodation is conveniently placed. Meat, fish, milk, and other organic foods are so susceptible to contamination from impure air, that the greatest care is needed to keep them untainted, and the very usual close proximity of the larder or pantry to the w.c., to open dust-bins, and other equally objectionable places, cannot but be regarded as a source of danger and an arrangement most repugnant to the crudest ideas of the fitness of things.

The dark, ill-ventilated cellar is no place for the storage of such goods, neither is the close, unventilated cupboard under the stairs, although the latter place is often absolutely the only provision for such storage in small houses.

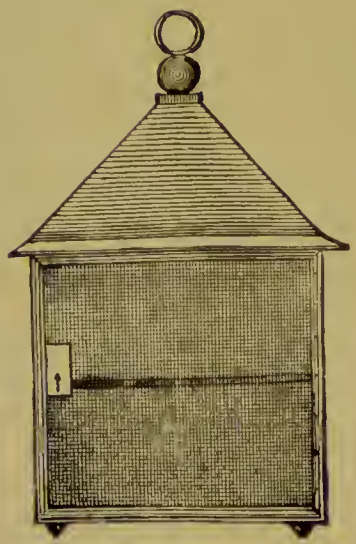
Food Storage. Cupboards in sculleries or in kitchens are suitable only for the storage of dry foods, and then only under very favourable circumstances. In fact, the matter of providing safe and desirable keeping-places for food offers a problem for the most careful thought.

It may not have occurred to us that we have personally suffered any ill-effects from our own faulty methods of food storage, though possibly we have remembrance of slight attacks of diarrhœa or dyspepsia which were difficult to account for at the time, and certainly were not attributed to such a source, yet it is more than probable that such was the cause. Diarrhœa is but the symptom of many diseases, and we are foolishly running great risks when, knowing the facts, we neglect the needful precautions that the exercise of a little contriving would enable us to observe.

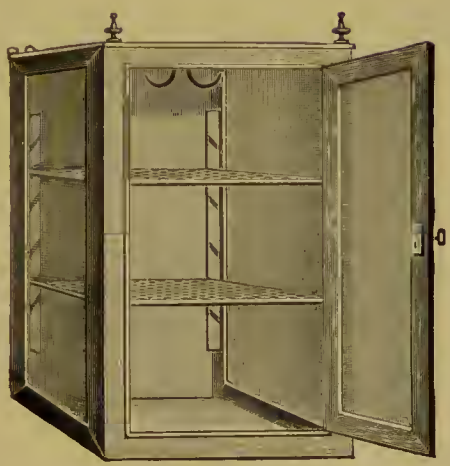
Cupboards or safes for meat, fish, butter, milk, etc., may be hung in



SAFE FOR THE STORAGE OF MEAT, FISH, MILK, BUTTER, AND OTHER EASILY CONTAMINATED FOODS



HANGING MEAT SAFE



SAFE WITH PERFORATED SHELVES, ALLOWING OF MORE COMPLETE AIR CIRCULATION.

TYPES OF FOOD SAFES

the open air, provided that the situation is shady and the contrivance is protected from wet. The near neighbourhood of gullies, sink outlets, ventilating pipes, soil pipes, or w.c.'s should, of course, be strictly shunned, and a very wide berth given to dog-kennels, rabbit-hutches, fowl-houses, aviaries, dust-bins, or the place of deposit for any description of refuse. Light and fresh air must have free access to such keeping-places.

Store Cupboards. Sufficient cupboard room is desirable in all departments of the home, for the storage of clothing, linen, preserves, dry goods, china, etc., and the general lighting and ventilation of many such places might be advantageously considered. This may appear to be altogether unnecessary, but when we recall our acquaintances with musty store cupboards, linen closets infested with moth, damp and mouldy boot-cupboards, and similar unpleasant places, the suggestion does not seem so very extraordinary.

Coal Store. Coal cellars, cupboards, or bunkers should be as far removed as possible from the neighbourhood of the pantry, larder, or safe, and where coal is shot in a large cellar it should have its own enclosure with a door to prevent the dust from flying abroad when the place is being re-stocked.

The cottage coal-store is frequently situated under the stairs, and practically in the living-room or kitchen, or if such storage is provided by an annexe built in the rear of the house the door often opens directly out of the scullery or kitchen for the sake of convenience. Under such circumstances the difficulty of keeping the place clean is increased, and the convenience is purchased at the price of much additional labour in this direction.

Basement. Basement rooms are deservedly avoided by a great many people, although when properly constructed they may be perfectly healthy, with the advantage of being cool in summer and warm in winter. But usually such rooms are damp, insufficiently lighted, and badly ventilated, with the result that the dwelling, although otherwise excellently fitted and arranged, is rendered unpleasantly humid and stuffy by the circulation of the tainted atmosphere from these rooms.

No basement should be constructed with more than one-third of its pitch or height below ground level—that is to say, if the height of the room is 9 feet, then at least 6 feet of this should be above the ground. Moreover, the earth should be cut away so that an open area or passage is formed between the house and the adjoining ground, and this should be dug at least 18 inches below the level of the basement floor and properly paved and drained.

Where basement stories exist which are not constructed in the above manner, the conditions may be improved by carrying out the following suggestions: In order to admit a sufficiency of light the ground in front of the windows may be cut back at a slope of 45 degrees with the horizon, and the slope turfed. Where the construction of an open area is impracticable along the whole length of the wall, the intrusion of damp may be checked by building an outer wall with a space or cavity between that and the original wall of at least 1 inch wide, which must be filled with bituminous asphalte or hygienic rock, or even common pitch, which is melted and poured in while hot.

No basement room is fit for human habitation which has the earth resting against the walls, or any one wall, without the interposition of some material to prevent damp and ground air from being drawn into the apartment.

Sheds. The harbourage afforded for rats, mice, and other vermin by the existence of sheds and out-houses close to the dwelling, used for storage of wood and other miscellaneous matters, is the source of considerable discomfort and inconvenience at times. The temptation offered to the amateur builder for the erection of such places seems irresistible, and far too many of these unlovely and insanitary structures are put up in gardens and yards, limiting the air space which is absolutely essential for the health of the home, and creating hiding-places for useless lumber and dirt, besides providing homes for the afore-mentioned creatures, which eventually find their way into the house.

Workshops, tool sheds, wood sheds, cycle sheds, aviaries, etc., are much better at some distance from the house, especially when built of wood.

A solidly paved concrete floor is desirable to all such buildings, to facilitate cleaning and to prevent the burrowing of rats or mice; and when corn, meal, or other food for poultry or animals is kept in such places, galvanised iron bins or boxes with closely-fitting lids should be provided for the purpose.

A little trouble and expense is wisely incurred in preventive measures against the establishment of vermin about the premises, where the presence of easily-gathered food is bound to attract them, for if once a footing is gained their eradication is often a difficult matter.

Stables. It is not any building in any position which is fitted for use as a stable, and the experiences of those who have adopted a makeshift economy in this respect have tended to the verification of this fact.

In small country establishments, where the stabling is frequently in very close proximity to the dwelling, the health of the stable has a distinct relation to that of the home, and apart from the anxiety and expense arising from sickly animals, there is always the risk of personal ailments and ill-health, attributable to its insanitary condition. Too little attention is often paid to the fact that the horse has not the constitution proverbially ascribed to him, and that he falls an easy victim to chills, dyspepsia, and contagious ills. A perfectly healthy stable must be situated on well-drained soil and should have a sunny aspect—south or south-east. Trees should not be allowed to obstruct light and air, and the surroundings must be kept free from unnecessarily large accumulations of manure.

Substantial construction is in the long run economical, both as regards maintenance and the health of the animals. Walls should be well-built, and at least 9 inches thick to ensure an equable temperature, and the same precautions should be exercised against rising damp as in the human habitation. Internally, the walls should afford as little lodgment for dust as possible, and those surfaces which are likely to be exposed to the direct breath of the animals, such as immediately over the mangers, or the walls of loose boxes, stall partitions, etc., should be made impervious to moisture by plastering with cement, covering with glazed tiles or similar means, if of brick, and by painting or varnishing, if of wood.

The building should be from 10 to 12 feet from floor to ceiling, when a room or hay loft is constructed over the stable, and 10 feet from floor to eaves where there is an open roof. Stalls should be at least 6 feet wide from centre to centre of stall partitions, and loose boxes should be roomy, not less than 10 to 12 feet square. The whole stable should be large enough to afford a capacity of at least 1,000 cubic feet to each horse.

The paving of the stalls and boxes must be of material impervious to moisture and of such a character that good foothold is possible, and laid so as to drain towards the centre and back of the compartments. Too much fall is usually given, resulting in discomfort to the animal when standing long in the stable.

It is better to conduct all drainage from the stable by means of shallow, open channels, formed in the paving to gullies situated outside the building, instead of the very usual method of fixing horse pots or gullies at the back of the stalls, and in the boxes; and deep channels covered with gratings or any similar contrivances, which collect and retain filth within the stable, should not be tolerated.

Sufficient light must be admitted by windows placed in the wall at the back of the animal to illuminate the whole interior, and ample provision made for ingress of fresh air by tubes or ducts arranged in the window sills, or hopper openings in the window itself. Roomy outlet ventilators, in the form of zinc, lead, or iron shafts, must be carried from the ceiling through the roof and protected by cowls, or some equally efficient means adopted for the discharge of vitiated air, but sharp draughts from either inlet or outlet ventilators upon the occupants of the stable must be avoided.

Isolation Boxes.

Where several horses are kept it is advisable to provide an isolation box, cut off entirely from any means of communication with the rest of the stable, for use in cases of influenza colds or other infectious ailments. If, as a rule, each horse has its own drinking bucket, kept exclusively for the use of that animal, colds and similar troubles will be much more easily controlled. Extreme cleanliness should be observed with regard to all drinking vessels, mangers, and food receptacles, and indeed throughout the stable.

Section II.—Water-supply

CHAPTER IV

WELLS, PONDS, STREAMS, RAIN-WATER

"Till taught by pain,
Men really know not what good water's worth."—BYRON.

PRIMARILY, the location of man's settled dwelling-place was decided by the situation of some easily accessible water-supply, and the near proximity to rivers and streams of many of our towns and villages is due to the dependency of animal life upon an abundant supply. But what sufficed for a sparsely inhabited district, or fulfilled the needs of a scattered village, proved totally inadequate when in the course of time a populous township had evolved from the village, or the district had become a highly cultivated area, crowded with domesticated animals and plentifully besprinkled with the habitations of men: not so much by reason of the inadequacy of the supply as the multiplication of the sources of its contamination.

The frequent scourges of disease in the Middle Ages, and indeed of much later times, were due largely to the ignorance or neglect of this fact; and Nature's revolt against such conditions of life were for the most part accepted as the visitation of an offended Providence: a punishment for the commission of sins quite foreign to the acts which merited such retribution.

The use of the shallow well so familiar to many of our towns within quite a recent period is happily growing less, even in the most remote centres; but by far the greater part of the rural population has still to rely upon this or similar means for its supply.

Streams and ponds fulfil this duty in many neighbourhoods, the latter in some cases being almost entirely fed by surface drainage. When these are situated in the midst of heavily stocked and highly manured lands, to say nothing of the near neighbourhood of a number of badly or imperfectly drained houses, the risks are so great that one cannot wonder that disease, yet so rife, was still more prevalent when these conditions were common to the whole country.

To the dwellers in city or town, where the ever-available water-tap is never irresponsive to the applicant, the inestimable advantage of a copious and pure supply of water is taken as a matter of course, No thought is entertained of its limitations, nor a doubt of its integrity. To such, the condition of the very many less fortunate beings who live in districts far removed from the distributing areas of properly organised supplies will read like a page from medieval history.

Wells.

The well is usually dug in a position very near to the house, as causing the least possible expenditure of labour in satisfying the family demands. It is therefore not far removed from the conduits or receptacles which convey or retain the wastes of the family, and frequently in the near neighbourhood of piggeries or stables.

Generally, the well is sunk to no very great depth (under 70 feet) in a porous soil, and acts as a sump or drainage-pit toward which any moisture falling on the soil for some distance around naturally and readily gravitates. The harder the well is drawn upon, or the more it is used, the more free becomes the drainage toward that point, facilitated by a natural bending or depressing of the lower strata toward the well. Added to this is the fact that the well top or cover is often at or beneath the surface of the ground and the lining or walls are of dry brick or stonework, i.e. built without mortar, allowing the surface drainage free access. Yet so long as the water is bright and clear the householder will swear by its virtues and even prefer the peculiar flavour of his own well to that of any other water. That appearances are not always to be relied upon is truer in this respect than in many another, and a supply polluted to a very dangerous degree may still sparkle in apparent innocence.

Stains or stream marks down the sides of the well, discoloured patches of greenish or brown stain on the brick or stonework will mark the presence of undesirable soakage, and a more or less offensive odour arising from the water when boiled will proclaim its very doubtful character. Wells of a deeper bore, when situated amidst such surroundings as usually exist in the immediate neighbourhood of a country house, are not to be trusted, and an instructive instance may be here quoted of a well of high local repute sunk 200 feet into the solid chalk, whose waters were decidedly tinctured with the drainage from cesspools that were within 30 feet of it.

It may serve a useful purpose to define the difference between a shallow well and a deep well, as a shallow well may be dug to a greater depth than a deep well, so called, the difference in nomenclature being entirely due to the disposition and nature of the geological

Diagrams illustrating various Types of Wells.

Fig 1 Shallow Well.

Fig 2. Deep Well.

Fig 3 Shallow Wells

Fig. 4. Artesian Well.

strata pierced. In some localities gravel, sand, or porous rock may lie close to the surface, and beneath this there may be a bed or stratum of clay, which prevents the further soakage of water. Wells sunk into and depending for their water upon the porous strata lying above the clay are called shallow wells; but if the boring is carried down through the clay and draws its supply from the porous strata beneath, it becomes a deep well.

In the case of Fig. 1 (p. 29), all waters falling upon the area limited by the clay basin are drawn toward the well, and the purity of its water is directly dependent upon the depth and nature of the soil, and the amount of surface or sub-soil pollution to which it is subjected by cultivation and occupation.

With Fig. 3 (p. 29) we have somewhat different conditions, as the porous strata has a natural drainage outlet at the river, and the water intercepted by the well is likely to be purer; but all shallow wells, whatever may be their depth, are to be looked upon with suspicion, even when situated some distance from any possible source of pollution.

Protection for Shallow Wells.

It has been suggested that water entering a shallow well at a depth from 6 to 12 feet from the surface has passed through a sufficient thickness of filtering soil to be considered safe, and various measures have been suggested in the way of lining the well with cement-plastered brickwork, or glazed stoneware pipes to a depth of 12 or 15 feet, in order so to control the soakage that it shall get a certain amount of filtering before entering the well. But such expedients may be altogether useless, particularly in strata with open fissures, and in very coarse gravels. No hard-and-fast rule can be laid down for such protection, but each instance must be considered by itself and receive treatment accordingly.

The well top in all cases should be kept above the ground level, and a sufficient area concreted around it to drain away surface waters from the mouth of the well, which should be provided with a good weather-proof lid or cover.

Artesian wells are deep wells, usually of small bore, drawing upon a water-storage which is under considerable pressure owing to geological conditions. In such wells the water is forced up to a considerable height in the tube, and often to overflowing (see Diagram, p. 29).

Dip wells are shallow basin-shaped depressions formed at the issue of a spring or at the side of a small stream.

Ponds.

Ponds may be fed by streams, by more or less deeply-seated springs, or depend almost entirely upon surface drainage for replenishment, but whatever may be the source of supply

their usually unguarded state renders them very liable to pollution, and unless the pond is of large size, spring-fed, unusually well situated with regard to access of air and sunlight, and moderately deep, its waters must be regarded with the gravest suspicion.

In many agricultural districts the pond is the sole source of water-supply for all purposes, and is most frequently situated close to the dwelling or farmyard, and often entirely surrounded by various buildings, the drainage from all of which directly or indirectly runs toward this reservoir.

A case in point may be quoted which is not an extreme example of many such instances in the same neighbourhood. The farm-house probably dates from the fifteenth or sixteenth century, and was originally surrounded by a moat. This is now partially filled in, but its former course can be traced by three ponds connected by an almost continuous dry ditch. The horse pond on the one side receives the drainage from stables and stock-yard, and over the ditch, which runs in the direction of the next pond, stands the privy or midden. The ditch, still strongly marked, extends to another pond at the back of the house, and this assists in the drainage of the adjacent piggeries. Still following the ditch, which is here not quite so apparent, we traverse the third side of the quadrangle and arrive at the clean water pond which supplies the household. The distance separating these ponds is not great, and the difference so inconsiderable between the water-level of the ponds and the floor of the filled-in ditch that direct communication in wet weather is very possible, even if the clay soil filling of the ditch is proof against soakage. The one saving condition of the whole situation is the strong cleansing agency of the iron with which the soil is heavily impregnated.

It may be pointed out that such dangerous conditions have existed for centuries with very little apparent resultant evil. But who can say what diseases, insufficiently investigated or understood, may not have arisen from such a source, or how much sturdier and stronger the race thereabouts might have been under more reasonable conditions?

Springs and Streams.

In springs and streams intercepted near their source we find the supply most free from contamination. Such water, except for earthy salts, contains very little that is deleterious to animal life; but, except in very remote or thinly populated districts, the general carelessness or abuse of roadside dip wells and natural fountains reduce even such sources to the common level of suspicion. The utilitarian uses of the stream are so manifold that it has little chance in its course through even a sparsely inhabited

district of retaining the purity which distinguishes it at the source. Not content with harnessing the floods to his purpose in commercial enterprise, man pours into it wastes from his manufactures, drainage from stable, byre, and piggery and, what is worse, the wastes from his habitations. This easy method of disposal is pursued without thought or reference to the subsequent uses of the stream, and so much a matter of custom has it become that the conditions are apathetically accepted without demur by the inhabitants below, who in their turn add their quota of filth to make it a little worse for the next stage.

That disease is not more prevalent along the banks of some such streams is a matter entirely beyond comprehension, when one sees the actual conditions of these watercourses which probably feed a succession of mills and factories and flow thence to supply the needs of several villages or scattered hamlets below.

Nature's Purification. The action of air and sunshine toward purifying the water by oxygenation is assisted by the suspended mineral particles carried down with the stream, and by its contact with the earthy banks; but the extent of such purification is necessarily governed by the magnitude of the stream and the amount of pollution to which it is subjected. As the balance is not easily determined, this being a matter for scientific investigation, extreme caution in the use of such waters is advisable.

Some streams are, of course, above reproach; but these are remote from manufacturing districts, large villages, and highly-stocked or cultivated lands.

Rain-water. The storage of rain-water as a supply for domestic use is adopted in some neighbourhoods as the alternative to sinking deep and expensive wells or dependence upon surface supplies of doubtful character. Such is the only available supply of many houses situated upon the higher levels of the chalk downs, and, although the water may be comparatively good when collected, its storage in unventilated and badly constructed tanks or reservoirs, which are seldom cleaned out, leads to a rapid deterioration in its quality.

With suitable accommodation for rain-water storage, the difficulty of a safe supply for drinking and culinary use may be solved where polluted wells and more than doubtful ponds are the only other sources at command; water from the latter can, of course, be utilised for washing, bathing, and cleaning.

Rain-water as a beverage is to most people disappointing and unpalatable, but we are assured by those who have been driven to the necessity of giving it a fair trial that the taste for it is easily acquired; but,

after all, the matter of taste is a small consideration when the choice lies between this and water from a polluted source.

Rain collected in country districts, remote from factories or large communities, contains a very small amount of mineral matter and a percentage of air gases, and is quite safe for domestic uses. Some care, however, is needed in collecting, as the roof which forms the collecting area becomes fouled by birds and dust during a drought, and the first hour's rainfall after such a period contains the washings of roof and gutters, and also the greater proportion of the impurities washed from the atmosphere. Therefore it is necessary to turn aside or run to waste this amount by some suitable device. An automatic separator for this purpose is made by several manufacturers.

It is, of course, essential that eaves, gutters, valleys, and all pipes and channels through which the water passes should be kept free from leaves, dirt, and birds' nests. The latter trouble may be minimised by covering with wire caps or cages all eaves and valley gutter outlets, hopper heads, and similar openings, to discourage birds from attempting to utilise such places for family purposes.

Rain may be collected by paving a suitable area of land with cement or asphalt, from which the rainfall is conducted by pipes into storage tanks, the space being carefully fenced in and protected from the invasion of animals, and the surface kept scrupulously clean; but this is only possible where expense is the least consideration.

The quantity of water to be collected from a given area depends, of course, upon the amount of rainfall. This is by no means regular month by month throughout the year. In England the driest months appear to be September and March, and in the former month there is often a prolonged drought extending over a period, sometimes, as in 1907, of three weeks. Although the average rainfall in this country is about 34 inches per annum, the amount falling in different localities varies greatly. A modest computation of about 24 inches, which is an average for one of the less favoured districts in this respect, will best serve our purpose. It is estimated that 20 per cent. of the rainfall upon roofs is lost in evaporation, and it may be assumed that a further 20 per cent. will be lost by running to waste, by overflows, washings of roofs, etc. The available quantity for domestic purposes will therefore be 60 per cent. of the annual rainfall, or about 14½ inches. One inch of rain falling upon 1 yard square of roof surface, measured horizontally, is equal to 4.67 gallons, or, allowing for the above-mentioned percentages of waste, 67¾ gallons per year. Even with small property the roof area would average 100 square feet to each inhabitant, or 11⅑ square yards,

giving a yearly yield of about 760 gallons or over 2 gallons per head per day. One gallon per head per day is an ample allowance for drinking and cooking, according to the military scale, and as the proportion of roof area to each inhabitant is likely to be even greater than that given, in any but overcrowded houses, each dwelling is provided with a sufficient area to afford a supply for these purposes, at any rate. In many instances where it is advisable to utilise rain-water for all purposes, the roofs of other buildings, such as stables, barns, etc., may be available for collecting areas. Slate-covered roofs are the most desirable for this purpose, as they do not collect and retain so much rubbish as coverings of tile or similar material, nor are they so subject to growths of moss and lichen. Corrugated-iron roofs are unsuitable, as the rain-water attacks and carries away in solution portions of the zinc coating, and for a similar reason water from lead roofs should not be collected. Roofs covered with tarred felt should not be selected, for obvious reasons.

Rain-water Storage.

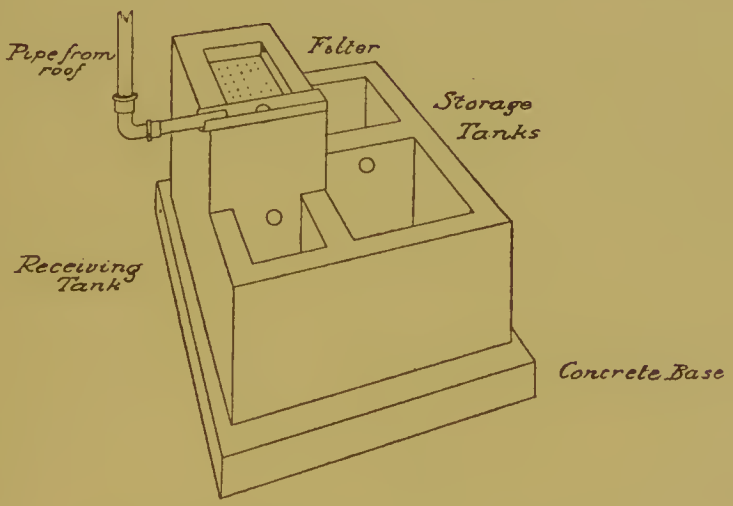
The usual means of rain-water storage are underground tanks or wells, from whence the water is drawn by a pump, slate or lead-lined cisterns, or iron tanks above ground. The underground tank, as a rule, has many faults which it is imperative to avoid. In the first place, the top or cover is level with, or just below, the surface of the ground, and is not impervious to soakage of surface drainage—in fact, the cover often forms part of the paving of a yard or area which is frequently badly laid and unjointed. The overflow pipe from the tank is not uncommonly connected with the house drains, so that sewer air has access to the water, and generally there are no means of ventilation provided. Storage in lead-lined cisterns is dangerous, and slate cisterns with red-lead jointing are not much better on account of the solvent action of the water upon this metal, resulting in the production of poisonous compounds. For the same reason, zinc or galvanised iron tanks should not be used.

If the storage tank is constructed entirely above ground it will be safe from many chances of pollution to which it may be subjected if below the surface—such as soakage from leaky drains or other receptacles of filth, the entry of rats, etc. The expense of digging saved will allow of more careful construction of the reservoir, and the pump may be dispensed with in favour of a draw-off tap.

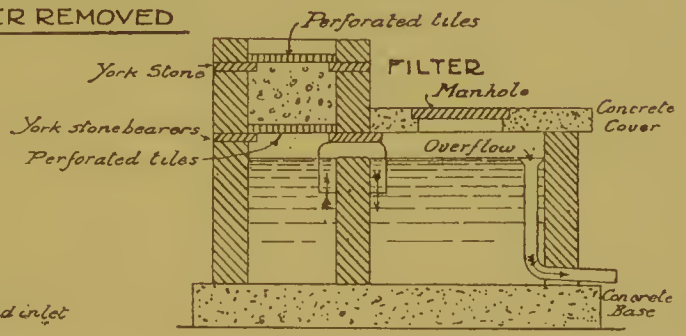
The tank should be constructed of brickwork built upon a floor or base of concrete, and the whole interior plastered out with cement and sand. If the tank is divided by a central wall with a communicating pipe at the top water level, the tank may be periodically cleaned

RAIN WATER STORAGE TANK

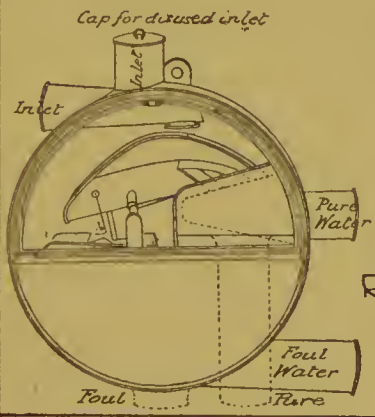
ABOVE GROUND



VIEW OF TANK
COVER REMOVED



SECTION THROUGH
FILTER & TANK.



RAIN WATER SEPARATOR
for use in addition to filter
(Gibbs)

out without upsetting the domestic supply—one half being drawn upon for a time and then cleaned out, while the other half is in use. The overflow pipe from the tank should be made to deliver into a paved channel above the surface of the ground, and should on no account be connected to a drain nor even be allowed to discharge directly over a gully. The top of the tank should be securely and substantially covered in to prevent mischievous tampering or the entry of undesirable matter.

It is better to receive the water in a collecting tank or chamber, which should also act as a filter, before allowing it to reach the storage tank. Such a chamber should be of sufficient capacity to hold the rainfall for the necessary period required for filtration. Here it should be explained that the efficiency of the sand or gravel filter depends upon the water remaining in contact with the filtering material for some time (two or three hours). An automatic device might be arranged to allow the water to escape into the storage tank at the end of such period.

The capacity of the storage should be amply sufficient to tide over comparatively rainless periods or long droughts, and this should not be less than six weeks' supply or 90 gallons per head, for drinking and cooking. Where rain-water is not needed for drinking and culinary use it is usually appreciated for washing and bathing purposes, and even then it is desirable that it should be clean. Much of the liquid so used is certainly not; in fact, it is frequently little better than dilute sewage, owing to the filthy condition of the reservoir. The use of such a compound is unwise, especially when quantities are habitually exposed in open vessels about the bedrooms.

If rain-water is caught and stored in open tanks or tubs for washing purposes, such receptacles should be provided with suitable covers to keep out foreign matters, to check evaporation, and to prevent them from affording breeding-places for gnats and other insects.

CHAPTER V

"GOOD" WATER AND HOW TO SECURE IT

"Honest water, which ne'er left man i' the mire."—SHAKESPEARE.

PURE water is an unknown thing in nature, the nearest approach to it being rain as it reaches the earth in localities far removed from factories or dwellings of man, and even this has collected various impurities in the form of dust and gases during its passage through the atmosphere. Spring water at the best is tinctured with earthy salts and mineral matters to a greater or less degree, and is, moreover, liable to the addition of impurities of a more dangerous character.

Good Water.

A good, or safe, water is the term which we should employ to denote that which is fit for human consumption. To determine satisfactorily what is really safe and what is dangerous is the work of the chemist and bacteriologist, but there are simple tests which anyone may carry out to detect pronounced organic impurity. The judgment of the senses in this matter is totally unreliable, and it has been pointed out that a water may be bright, clear, and sparkling, and yet polluted to a very dangerous degree. Good water should be clear and bright, and is usually of a very pale grey-blue when viewed in a long glass tube. Some waters which are drawn from the neighbourhood of large moors or peaty areas, or those largely tinctured with iron, have a yellow or pale brown tinge. Such colouring would possibly lead to their rejection by the uninitiated, although perfectly safe. Any waters except those of very pale shades of grey-blue, bluish-green, or yellow-brown are to be suspected, especially when obtained from purely local sources, such as wells, ponds, or streams.

Cloudy Water.

A cloudy water is to be decidedly rejected. This term does not apply to that appearance which some water presents when freshly drawn from the tap and which quickly clears when allowed to rest. Such appearances are due to no more harmful causes than imprisoned air in tiny bubbles which speedily rise to the surface and disperse, or to the presence of many minute grains

of chalk or sand kept in suspension by the rapid movement of the water which fall to the bottom when the movement subsides. The cloudiness referred to as objectionable is a milkiness which is retained even when the water is perfectly quiescent.

Taste and Smell. With regard to taste, a nasty flavour should be a sufficient condemnation, though opinions differ so widely as to what is nasty and what is not that people have been known to drink for preference water obviously and grossly impure, to which they had become accustomed, when good and palatable water was within reach. Others frequently reject as distasteful an unfamiliar, yet perfectly good water, entirely on account of its flavour. For instance, a person accustomed to the most palatable and pleasing water from the chalk will detect an unpleasantness in the flavour of water from the greensand, while moorland waters and waters impregnated with strange salts will be quite repugnant. Again, perfectly good rain-water or boiled water is flat and insipid, and therefore distasteful to many.

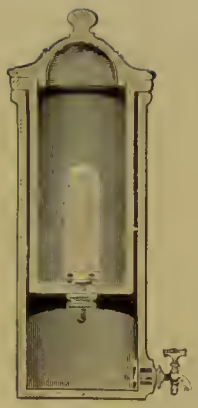
The nose has no discriminatory power as to the wholesomeness of water, and may accept without offence the product of the shallow well or polluted stream and curl with annoyance over the peaty or iron-stained water of undoubted safety.

Tests. If a bottle is nearly filled with water and vigorously shaken, a multitude of tiny air-bubbles are formed, which rise to the surface and disappear when the shaking is discontinued. With good water these bubbles rise quickly and burst immediately they reach the surface; but if the bubbles move sluggishly and hang awhile unbroken at the top the water may be assumed to be of a very doubtful character.

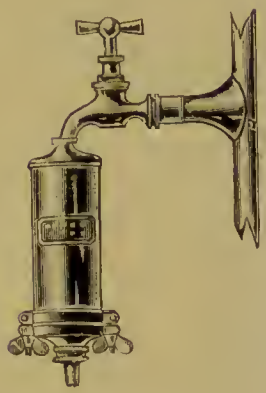
Nature is constantly striving to purify both earth and water by attacking the particles of dead or decaying organisms and converting them by the action of oxygen into harmless compounds. The "Condy's" test for water is based upon this fact. Condy's Fluid contains a quantity of oxygen which readily combines with any organic matter within its reach. This action changes the chemical construction of the fluid and robs it of its distinctive colour. To carry out the test a glass tumbler is filled with the water to be examined, 60 drops, or one teaspoonful, of what is known as dilute sulphuric acid is added to accelerate the action, and the mixture well stirred with a strip of glass. Enough Condy's Fluid is dropped into the vessel to colour the water a pale purple, the tumbler is then covered with a clean plate, and the appearance noted. If the water is very bad the colour will quickly

GLASS TABLE FILTER

DECORATED STONE-WARE FILTER

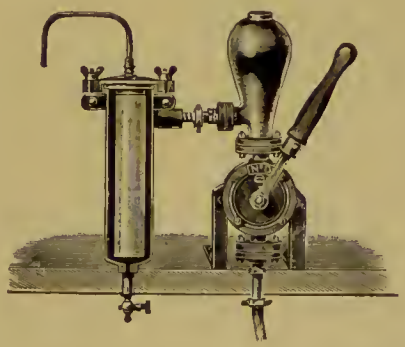


SECTION THROUGH STONEWARE FILTER



HOUSE FILTERS FITTED TO SERVICE SUPPLY FROM MAIN OR CISTERN

FILTER FOR OCCASIONAL USE: CALLED "SEASIDE FILTER"



FILTER FITTED WITH PUMP

MODERN FILTERS: THE "BERKEFELD"

fade from purple to pink, from pink to a light straw colour, until it disappears entirely. The rapidity of this action will coincide with the degree to which the water is polluted. The quicker the fading or discharge of the colour the worse the character of the water under examination; but let the fading be ever so slow this action inevitably betrays organic pollution to some extent. Permanganate of potash will also answer for this test.

Another simple test may be conducted by filling a perfectly clean tin pan of shallow form with about one pint of the water and standing it upon a heated stove. Let the water boil gently, until all in the pan has evaporated, then carefully examine the sediment left. If the substance is white and chalky and in a fine powder, there is probably nothing much the matter with the water, but if we can see here and there darker spots or lumps, which upon further heating of the pan blacken and burn, giving off meantime an unpleasant odour, it betokens the presence of considerable organic impurity.

All water to which the slightest suspicion may be attached should be well boiled before using. Boiled water for drinking purposes may be cured to some extent of its flat, insipid taste by pouring it quickly a few times from one vessel to another, thus partially restoring the air driven out of it in the process of boiling.

Filtering. Filtering is a subject which one approaches with a great deal of hesitation, for, although excellent forms of the domestic filter are to be obtained, with many of them their proper care and use is surrounded by difficulties, and results are of great uncertainty unless the appliance is in the hands of a scientist or an enthusiast of an uncommonly painstaking variety. The filter craze of thirty years ago has left its impressions, and many of us have weird recollections of the erratic contrivances of this description. Most of these were used year in and year out without a thought of recharging or cleansing until the abomination was no longer supportable, and one threw caution to the winds and drank the unfiltered liquid rather than the evil-smelling product of the so-called purifier.

The action of many filters is entirely mechanical and the impurities removed by the passage of water through the filtering media are not destroyed or altered, but simply transferred from the water to the media. It follows, therefore, that a time will come when the filtering material is so loaded with these impurities that it is not only unable to continue its work of separation, but actually adds a portion of the accumulated filth to the water passing through it. Therefore frequent and periodical renewals of the filter charge is essential, the frequency

of this recharging depending upon the work demanded of the filter and the character or amount of pollution contained in the water passed through it. The introduction of such filters as the Berkefeld has rendered filtration a matter of greater certainty and simplicity, but it is, of course, necessary that such appliances should be intelligently used and in accordance with the specific instructions supplied with them. The illustrations of this filter show the manner in which it can be adapted to the ordinary fittings if required.

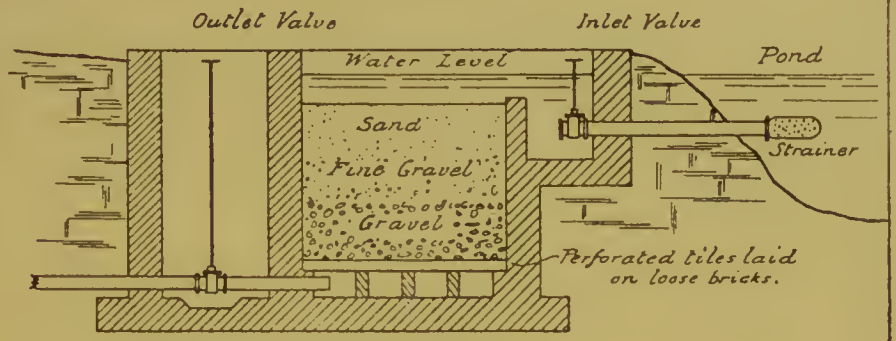
The suggestion of a less expensive arrangement, imperfect though it may be from a scientific standpoint, may serve a useful purpose. As the suggested filter has no pretensions to being germ-proof, sterilisation of the water by boiling is necessary.

Boiling. We are told that the bacilli of such diseases as typhoid and cholera are easily destroyed by heat before the water containing them reaches boiling-point; but a good hour's boiling is necessary to effect the destruction of more hardy germs. Spores or embryo germs are difficult to destroy; therefore water should not be boiled in too large quantities and allowed to remain unused for lengthy periods.

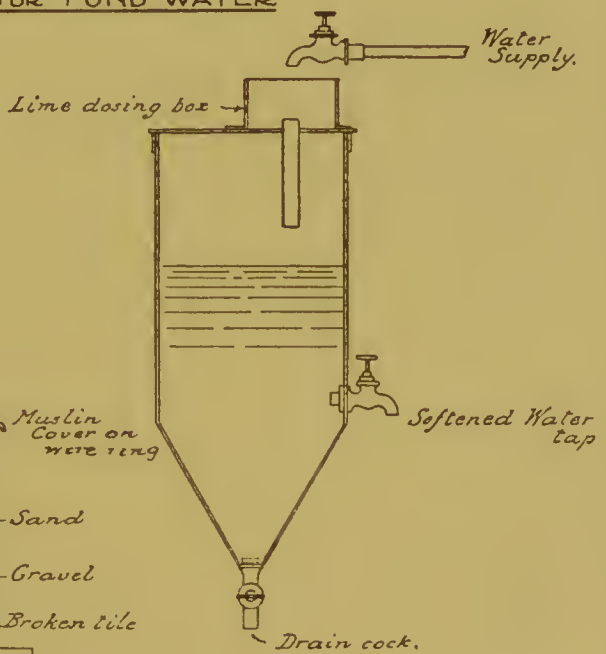
Owing to the facility with which water absorbs gases of all kinds, especially when cooling, it is desirable first to pass the water through the filter and then to boil it. For the same reason the position of the filter should be one that is far removed from any possible source of objectionable effluvia, such as sink, gully, w.c., ash-pit, etc., and preferably in the open air.

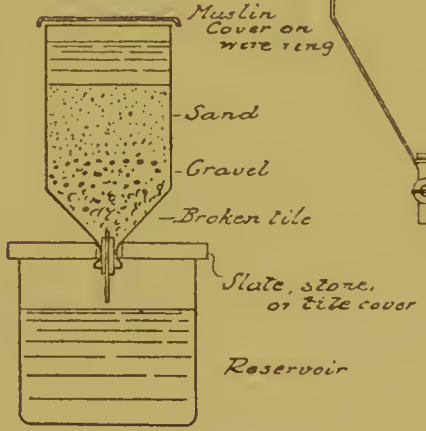
Simple Filter. The suggested filter may be made from a large flower-pot, an inverted two-gallon stoneware jar from which the bottom has been neatly cut, or any similar vessel of pottery or stoneware, with a convenient hole at the bottom to act as an outlet. Fill up the first two or three inches with small pieces of clean broken brick or tile of the size of filberts. On this place three inches of clean washed gravel the size of peas, and top up with six inches of coarse, clean washed sand. Each layer must be gently but compactly rammed in, and the top layer should be covered with a well-perforated pottery tile made to fit the vessel, or a piece of filter paper, as suggested by Dr. Thresh. The tile or the paper will arrest much of the coarser matter, and can be cleaned or renewed as occasion requires. The hole in the bottom of the vessel must be plugged and a tapered tube of stout glass inserted, of such a size that the water can only escape in a very thin stream, so that its passage through the filter is slow. This tube should be carried through a hole in the cover of a stoneware crock or reservoir.

WATER SUPPLY



FILTER FOR POND WATER





TANK FOR WATER SOFTENING
(Section showing construction)

SECTION OF SIMPLE FILTER

The filter should be provided with a muslin cover, stretched tightly over a wire ring which loosely fits the top, to keep out dust and other foreign matters.

If the filter is constructed in duplicate, alternate use will allow each a very necessary period of rest and aeration, and also allow of periodical cleaning and recharging without upsetting the family supply. The filtering material should be renewed or taken out and thoroughly washed with plenty of water, and the vessel cleaned at least every two months. If a larger vessel is obtainable, the thickness of the layers of filtering material should be proportionally increased.

Hard Water. Hard water is that which contains an excess of lime and magnesia salts over and above a certain number of grains per gallon.

This is usually expressed in degrees, one grain per gallon being equal to one degree.

The presence of sulphates of lime and magnesia constitutes what is known as permanent hardness, and that of bicarbonate of lime temporary hardness. It is this temporary hardness which has now our consideration.

Soft Water. Water containing from 5 to 10 grains of bicarbonate per gallon is considered soft, but if in excess of 10 grains the water is said to be hard. From the point of economy soft water is to be preferred, as the harder the water the more soap is required for washing operations, and more material in making tea, coffee, etc. But for drinking purposes a hard water appears to be not only more palatable, but more beneficial to health.

From the statistics of nearly thirty large towns supplied with soft and hard waters, the average death-rate during ten years was considerably larger in those towns using soft waters, and although chalk gout and gravel have been largely attributed to the use of hard waters, the general consensus of medical opinion leans to the use of hard water in preference to soft.

To Soften Water. The softening of water for domestic purposes other than drinking is perhaps worthy of consideration, especially where the water is extremely hard. Moreover, the process of softening not only removes the bicarbonate, but destroys organic matter and precipitates all suspended particles. The process is simple, and consists of the addition of lime to the water to be treated, which, combining with the excessive carbonic acid, produces carbonate of lime, which falls to the bottom of the vessel, carrying with it much of the carbonate held in solution. It is usual to add carbonate of soda to counteract the lime sulphates.

Powders are sold by chemists for softening water for toilet purposes, "Anti-Calcaire" being a well-known proprietary production.

Another is composed of: Slaked lime, 1 drachm; dried carbonate of soda, 2 drachms. A little of the powder is put into the water an hour or two before it is required for use.

But if it is desired to carry out the operations upon more exact lines and on a larger scale the approximate hardness of the water, permanent and temporary, should be known, and this entails the services of a competent analyst, who will for a small fee provide the necessary information. The water may then be treated as described above in a suitable tank or vessel and drawn off for use as required.

To each gallon of water to be treated add ¾ grain of slaked lime for every degree of temporary hardness, and 2 grains of carbonate of soda for each degree of permanent hardness.

The best form of vessel is a tank of the character shown in the sketch on page 41, which may be of any size suitable for the household requirements or the space at liberty for its accommodation.

The salts may be mixed in a gallon or so of water and poured into the already partially filled tank. Allow it to stand for twelve hours before use, when supplies may be drawn from the tap at the side of the tank.

When two or three charges of water have been treated the lower tap should be opened and the accumulated deposit or mud at the bottom of the tank drawn off into a bucket and thrown away.

Such a tank may be found particularly useful where the water contains a great amount of matter in suspension, which can be effectually precipitated by this operation, before the water is finally filtered, and so get rid of a great deal of impurity which would otherwise choke the filter.

CHAPTER VI

WATER-SUPPLY FITTINGS

"It is not the water we use, but the water we waste that gives cause for anxiety."—Dr. Hugh Mill.

The attainment of luxury realised by the free enjoyment of a good and safe water-supply from a properly conserved and guarded source is insufficiently appreciated. Bounteous as the supply may be, economy is not to be ignored, and every householder owes it as a duty to himself as well as to others to make himself familiar with the nature and proper care of the various water-fittings with which he is supplied to that end. The contempt which we are told is bred by familiarity may account for the lack of interest with which such small matters are contemplated; but it is very desirable that every detail of such kind should be common knowledge, in the interests of comfort as well as of economy. Much trouble and a great deal of expense might be spared yearly, to say nothing of the saving of water, by the prevention of burst water-pipes and frost-nipped tanks and cisterns, yet in most cases such mishaps are due to the fact that the householder does not know what to do, or is indifferent to the means provided for their prevention.

Service Pipe.

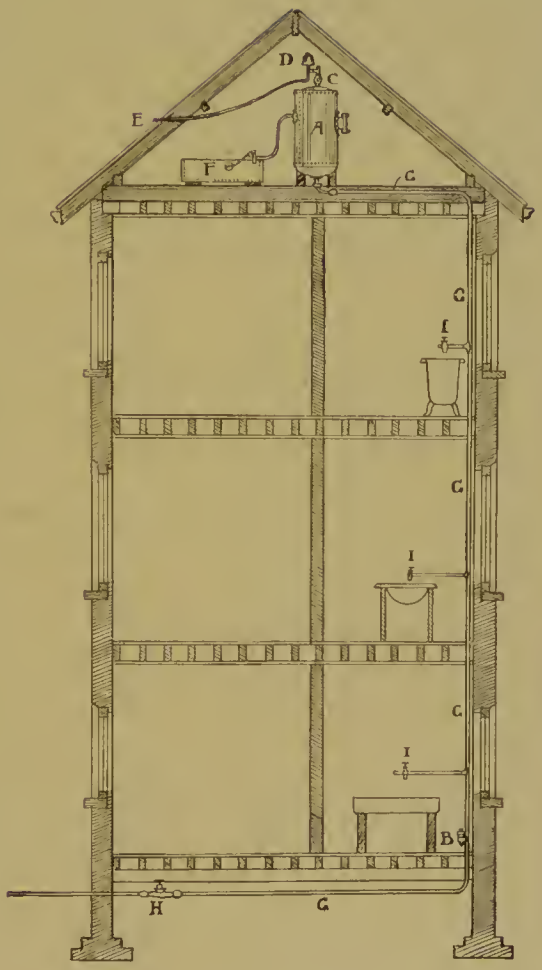
The water-supply pipes are usually taken in at the front of the house, the general practice being to carry off a separate pipe from the main to each dwelling, and on the public footpath or just inside the forecourt of the house is to be seen the iron surface box which covers the company's stopcock or service cock. This cock is the property of the Water Board or Water Company, and is intended for their use alone. The whole of the pipes and fittings on the house side of this cock are the property of the house-owner. It is his duty to keep them in repair, and he is responsible for any waste of water arising from the neglect of this duty.

The supply pipe, or service, enters the house through the cellar or, where there is no cellar, immediately beneath the flooring. Just inside the house the service should be provided with a second stop cock for the use of the householder, and immediately beyond that and on the house side there should be a drain cock. The purpose of these is to give

Fig. 3

REFERENCE

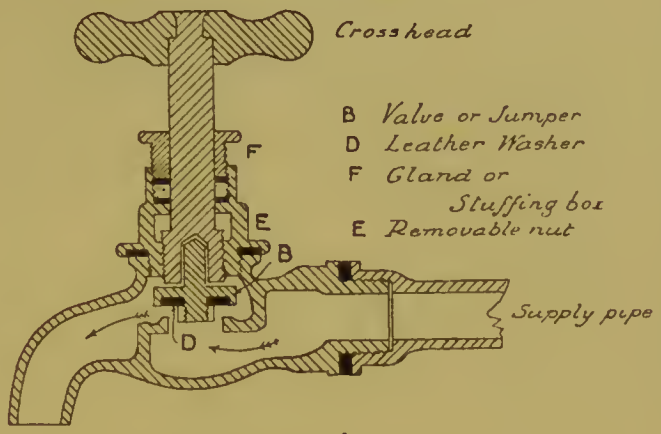
A. Storage tank
B. Retaining valve
C. Float valve
D. Air strainer
E. Overflow pipe
F. Hot water feed tank
G. Water supply
H. Stop cock
I Draw off taps



SECTION OF HOUSE, SHOWING ARRANGEMENT OF SUPPLY

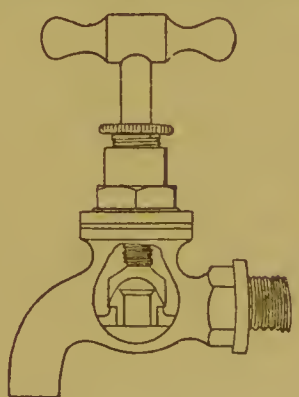
WATER SUPPLY : WATER STORAGE TANK

Details of Water Taps



Section of ordinary Bib Cock

Garratt Screw Down Cock



Washerless Tap. Hoare & Ackland

the tenant a direct control over the supply, so that he can shut off the water in case of accidents; or during hard frosts he may shut off the supply at night and empty the pipes by means of the drain cock, and thus prevent the water being frozen in them. During the daytime, when water is being frequently drawn and the atmosphere of the house is fairly warm there is much less risk of freezing, but it is when fires are out and the water lies stagnant in the pipes for hours together that the danger arises.

Stop Cock. The stop cock is often situated, in small houses, immediately inside the front door, a trap being cut in the floor boards to give access to it. The service pipe is carried from this point to the various fittings about the house, and it is advisable to become familiar with its course. Bib cocks, or taps, as they are more commonly termed, are fixed in positions most convenient for domestic use, such as over sinks, lavatory basins, baths, etc., and in stables and outhouses. Baths and lavatory basins are also fitted with supply cocks of a slightly different type. Water-closets are, or should be, supplied by flushing cisterns into which the water is fed through a ball valve. These cisterns are for flushing purposes only, and it should be impossible to draw water from them for any other use.

Taps. The stop cock and bib cock are usually of the screw-down pattern, constructed as shown in the sketch on p. 45. Some little confusion exists in the minds of most people in the use of such fittings as to which direction is off and which is on. With very few exceptions we turn the cross head from left to right, or with an outward twist of the right hand to shut off the water, and from right to left, or an inward twist of the right hand, to turn it on. When the head is turned from right to left the spindle rises and releases the valve B, which is forced upward by the pressure of water and leaves a passage for the escape of the water. When the head is turned in the opposite direction the valve is screwed down on to its seating and the leather washer D makes a water-tight joint. In shutting off, just enough pressure is required to settle the valve firmly in its place and any unnecessary tightening simply tends to destroy the washer.

Occasional annoyance is caused by the persistent dripping of the bib cock; in fact, some taps have a chronic affection of this kind. This is caused by the wearing of the washer, and this wearing is accelerated by the habit of wrenching the valve hard home on every occasion. Gentle use will prolong the life of the washer, and it should at no time be necessary to use force. If, in spite of all pacific measures, the tap still persists in dripping, a new washer is required. This is

renewed by unscrewing the tap, from right to left, at E, and taking out the valve B, but this can only be done after shutting off the water at the stop cock—quite a simple operation if the water is off, but productive of much trouble if attempted without observing that formality. Fresh washers of the size required may be obtained of most plumbers or ironmongers. If, despite new washers and pacific usage, the tap still drips, a remedy is only to be found in a new tap.

Re-leathering of the stop-cock valve necessitates the services of the plumber, as the water requires to be shut off at the Company's service cock, and this needs a special key to fit the square or D-shaped head of the service cock.

An escape of water is sometimes observed around the spindle of the tap, and this indicates that the packing of the gland or stuffing-box F requires attention.

It is agreed upon all hands that the working of the ordinary tap leaves much to be desired, and although troubles of this kind arise largely from the use of cheap and badly finished fittings, there is a real need for some device to surmount the difficulty of the rapid wear on washer and seating, which is the chief cause for complaint. Numberless attempts have been made to produce the desired effect, but the tap which will withstand the rough and unreasonable treatment of everyday life must needs be a contrivance of the utmost simplicity and perfectly fool-proof.

There appears to be some hope in the two latest attempts in this direction, but a long-continued use is necessary to prove their merit.

In Hoare and Ackland's washerless tap a hollow metal cone screws down upon a conical seating and makes a water-tight joint by a perfect contact of the two metallic faces.

The Garratt screw-down tap has a sliding spindle, which is raised or lowered by the screw action of the milled head or cap, and the rubber washer on the end of the spindle is pressed down to or raised from the seating without that grinding action which occurs with the working of the ordinary fitting.

Flushing Cisterns.

Flushing cisterns are of great variety, the most modern of which lay claim to some advantage over all others in point of simplicity, durability, efficiency, or action; but the principles of construction are broadly the same in all such appliances used for flushing the ordinary domestic water-closet. They are, briefly, a feed or supply valve designed to prevent waste of water, a siphon discharge which ensures a flush of the entire contents of the tank, and

an overflow pipe to prevent overcharging. The feed valve is usually regulated by a floating copper ball, which is attached to the end of a strig or lever. At the opposite or fulcrum end of this lever is a simple device for opening and closing the orifice of the supply pipe.

As the tank fills, the ball floats up and gradually closes the valve, and when the tank is discharged the ball drops with the water and opens the valve for the admission of a fresh supply. The flush is started by the action of a lever which lifts the cap of the siphon, displaces a plug, or in some other way causes a sudden rush of water into the outlet. This lever may be actuated by a pull chain or rod, a seat action, or a pneumatic device.

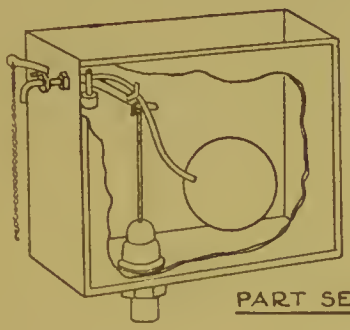
An overflow pipe is carried out near the top of the tank and should be taken through the wall into the open air in such a position that a discharge from it may be readily observed. On no consideration should this pipe be carried into the w.c. pan, into a gully, or be connected directly with a soil pipe or drain.

Overflowing of the cistern may arise from a defective or worn-out washer of the feed valve, from the copper ball becoming leaky and water-logged, or from the ball strig being bent so that the ball cannot rise sufficiently to close the valve completely. When the pressure of water is great some trouble is sometimes experienced in checking the tendency to overflow, and a very little defect in the valve washer results in continuous weeping. If, however, the supply pipe is provided with a stop cock, as it should be, the inflow may be decreased by partially closing this, leaving it on sufficiently to fill the cistern in a reasonable time. Such regulation will also lessen the noise of refilling, which is an objectionable feature of many flushing cisterns.

"Morgan" Dry Cistern.

The "Morgan" dry cistern is a distinct departure from the ordinary type of flushing cistern, and claims many advantages which should recommend its use. The supply is regulated by a ball valve as in other cisterns, but the usual action is reversed, the ball being lifted to admit the supply. A pull on the lever raises the ball, the cistern fills, and automatically siphons out as soon as the water reaches the top level. The ball falls with the water, closes the feed valve, and the cistern remains perfectly empty until the lever is again pulled. The tank being normally empty is consequently frost-proof, the ball does not get waterlogged, and the tank itself is not constantly exposed to the erosive action of the water. Moreover, the feed pipe is carried well down toward the bottom of the tank, ensuring silent action in filling.

Types of Flushing Cisterns

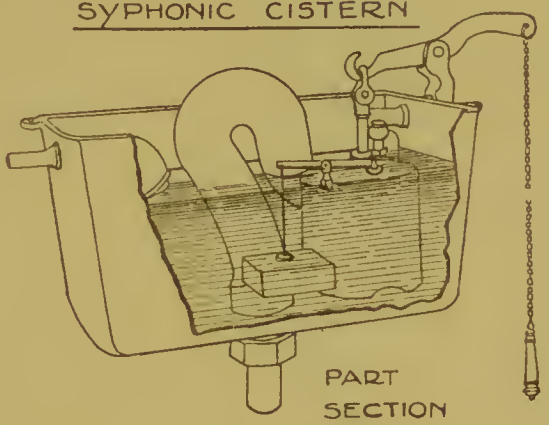


PART SECTION

VALVE CISTERN

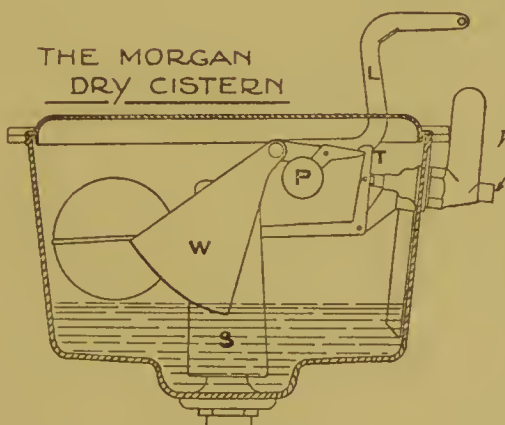
Cheap form in very common use.

SYPHONIC CISTERN



PART SECTION

THE MORGAN DRY CISTERN



SECTION

REMAINS EMPTY AFTER FLUSHING

Water Supply

A pull on lever raises weight and causes pawl to engage trigger
L
W
P
T

When L is released
W *falls causing*
P *to push back*
T *which opens valve and raises ball*

Water enters, floats ball, until syphon acts

Ball drops with water level. Valve closes and cistern remains empty until required to flush again.

Lead Poison. The activity of some waters in attacking lead pipes and lead-lined cisterns is due to a variety of conditions. Rain-water, and particularly soft waters, such as those from moorland gathering grounds or peaty soils, contain organic acids which have an affinity for this metal, and lead poisoning may result unless the water is filtered through animal charcoal to remove the lead.

Then an excess of lime is said to render the water liable to dissolve the metal, and the presence of certain salts, which may find their way into the water from sewage-contaminated areas, materially increase the action.

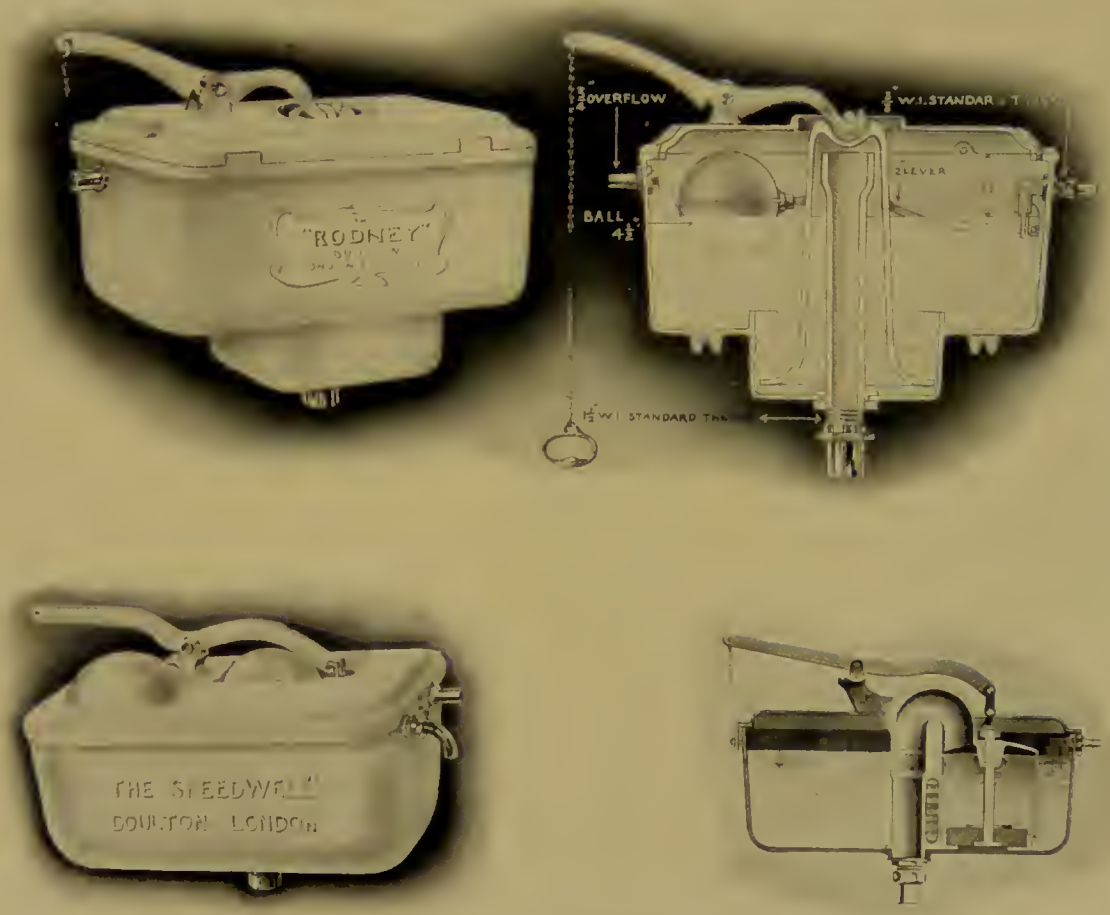
Storage of water containing a very small percentage of acids in zinc or lead-lined cisterns with brass or copper fittings sets up galvanic action in which these metals are readily attacked and broken up into harmful compounds.

Dr. Frankland suggests where water is conveyed through lead pipes that the supply for drinking and cooking should only be drawn after the tap has been in use for some little time in supplying water for other purposes, and as water is more active when hot in attacking lead, he counsels the sparing use of metal tea or coffee pots with soldered joints.

All waters, however, have a solvent action on the lead putty used by plumbers for jointing; therefore, slate storage tanks or cisterns with red-lead joints should have a luting or filling of Portland cement to protect the lead from the action of the water.

Galvanic Action. The galvanic action set up between the metals frequently leads to the breaking up of the solder joints of the ball-valve apparatus of cistern feeds, and the ball either drops off the strig or becomes leaky, and does not rise sufficiently to close the valve. Similar action with waters containing a large percentage of mineral salts tends to the rapid decay of valve seatings and the working parts of water-meters, etc.

Frost. When winter sets in and before frost becomes severe, protective measures should be taken to prevent the freezing of water pipes and fittings. The pipes which lie beneath the floors are usually safe unless exposed to sharp and direct draughts from the open air. This may happen when careless workmen have omitted to replace bricks removed from the external wall for the purpose of bringing in the service, or where air bricks are fixed in close proximity to the pipe. Exposed pipes in open areas, close to cellar windows, outside taps, and standpipes should be swathed with hay bands and covered with sacking and enclosed in wet-proof wooden casings, or bound round with



FORMS OF W.C. FLUSHING CISTERNS, WITH SECTIONS SHOWING ACTION

hair felt, or lapped round with several thicknesses of brown paper pasted on. Cocks and pipes under floors may be boxed in and embedded in sawdust or covered with hair felt, but in all cases the protective material must be kept perfectly dry. All pipes and cisterns should be protected from direct draughts from open windows or ventilators.

When the frost is severe a small light from a gas jet or an oil stove burned within the w.c. or bath-room may save a great deal of trouble and unnecessary expense.

Shutting Off. It is no good shutting off the water in order to avoid frozen pipes and fittings unless the water is drained out of them, and the common practice of leaving water-taps running and fixing down the lever pull of the w.c. is not to be recommended, as it may lead to disastrous results by flooding, owing to the freezing of the dripping water over outlets, to say nothing of possible complications with the water company.

If the water can be shut off and there are conveniences for draining the pipes, one may feel secure by adopting this course before retiring for the night, and, having emptied the pipes and cisterns, very little damage is possible.

Frozen Pipes. If a cistern or pipe should become frozen, immediately the mishap is discovered, flannels wrung out of hot water and placed round the frozen pipe, or hot water poured into the cistern, may remedy the evil. Should this treatment prove ineffectual, the apartment may be closed and well warmed, or that portion of the supply shut off, if possible, until the thaw sets in; the flooding which may result should a pipe or tap be split by expansion due to the freezing of the water may thus be avoided.

When the water has been turned off at night extreme care is necessary where there are self-feeding boilers or any automatic apparatus for hot-water supply or heating, to turn on the water before lighting fires, and to see that the water-supply is in working order.

Storage Cisterns. In those localities where the water-supply is intermittent or liable to fluctuation from various causes the storage cistern for domestic uses makes its appearance. The necessity for such an arrangement is to be deplored, and should be unnecessary except in very rare instances, as most towns have now a constant supply.

As a general rule, these cisterns are placed in any corner large enough for their accommodation, near the top of the house: often in the most badly ventilated part of the building, away from the light, and frequently in close proximity to bedrooms, housemaids' sinks, or

in a box-room or storeroom which is usually a repository for all descriptions of lumber, cast-off clothing, and dirty linen. The cistern is often so neatly stored away that it is never thought of unless something goes wrong, and it may be cleaned out once in three or four years or it may remain for a longer period without attention. Other positions chosen for the cistern are at the top of a bathroom, immediately over a w.c. or under a flight of stairs.

In view of the extreme susceptibility of water to contamination, any position which is not well ventilated and lighted is not to be thought of, and the situation should be as far remote as possible from bedrooms or any other likely source of vitiated air or impure gases. A portion of the space within the roof may be appropriated for the purpose, but such space should have a good system of ventilation and be efficiently lighted. Some protection in the way of a suitable wooden cover should also be provided to protect the water from falling dust or the intrusion of rats, mice, birds, or insects.

Periodical inspection is imperative to ensure that the supply is not being contaminated by the decomposition of foreign matters, and once every three months the cistern should be cleaned out thoroughly.

But the best form of storage cistern is a closed iron cylinder strong enough to stand the pressure of the water-service, and connected direct with the supply—forming actually an enlarged section of the service pipe.

Such is Harding's patent cistern, which is quite safe from the chance entry of foreign bodies or pollution by impure air or gases.

Section III.—Drains and Drainage

CHAPTER VII

SIMPLE METHODS OF WASTE-DISPOSAL

" . . . When 'tis done, then 'twere well
It were done quickly."—SHAKESPEARE.

THE importance of a speedy, systematic, and safe disposal of the wastes from the body and water fouled by man's use is a subject of the gravest moment, particularly in view of the possible effects of such disposal upon the water-supply, for whether in town or in country, and whatever may be the source of supply, the method of storage, or means of distribution, the chances of polluting the water are manifold. Besides this, there is the risk of disease arising from the fouling of the surface soil and the tainting of the ground air which frequently has free access to the dwelling.

Until quite recent times the gravity of the situation was not fully recognised, and the elevation of the subject into a science is still of tender years. It is therefore not surprising that, notwithstanding the rapid advance which has been made during the last half century, there still exist many ancient prejudices and old-world conceits which oppose the truths that the stern school of experience has offered for our acceptance. No other practice, it would seem, offers such a wide field for so-called experts, and certainly none is more liable to misconception.

The customary carelessness in dealing with human wastes in rural districts has been shown to be the survival of ancient practices against which Nature has persistently rebelled for ages, and the fact that many provincial towns are very little in advance of these primitive habits appears to be due to a seeming inability on the part of the general public to grasp the facts, until the truth is brought home by an unusually violent protest from outraged Nature in the form of an epidemic disease. Even where some carefully thought-out system has been adopted, careless workmanship often does much to mar the success of

the scheme, and this fact, combined with ignorant abuse of fittings, and the tampering of incompetent hands, have largely detracted from the good results.

Many isolated houses, and, for that matter, many villages and small townships, still use the midden privy for the disposal of the more solid wastes, while the slop-water and kitchen wastes are conveyed to the nearest brook, river, or ditch by open channels or roughly-made drains of ill-considered design and worse construction.

The Midden.

The midden privy, or cesspool, as it is sometimes called, is frequently constructed close to the main wall of the house, and not infrequently immediately at the back of the fireplace of kitchen or scullery, the heat from which tends to draw gases evolved in the evil-smelling pit into the house. Even if this is not so, the expanding gases have a more or less free passage through the rotted and faulty joints of the brickwork and under the ill-constructed floors into the house. When such a contrivance is placed at some distance from the house, adverse winds or a rise in temperature render its existence painfully apparent, and the house is never free in the warmer months from the swarms of flies which it attracts.

To those accustomed to the presence of such arrangements its unpleasantness is a matter of little concern, and might be neglected were it not for the harbouring of dangers of which the senses try to warn us.

The habitual breathing of deleterious gases, however much they may be diluted with fresh air, is bound to have an effect upon the human system, impairing the organs and making them more susceptible to disease.

Again, the facility with which water and milk absorb such gases and the ease with which organic food generally is contaminated by such conditions makes the matter of still more serious import. Of the unknown wanderings of the fly we would perhaps prefer to be ignorant, for the contemplation of the uncleanliness of its habits and the possible transfer of iniquity by its agency to articles of food is revolting in the extreme. Yet imagination could scarcely conjure up anything more horrible than the real facts.

Kitchen Slops.

The general belief that kitchen slops may be safely disposed of in a manner forbidden to sewage proper is a great mistake. From numerous analyses of the two forms of wastes, chemists have concluded that they are of identically the same constitution. It is therefore necessary that the same amount of care should be exercised in the disposal of one as of the other.

SIMPLE METHODS OF WASTE-DISPOSAL

The pollution of ground air by surface contamination and the risk of poisoning the sources of the household water-supply is in many cases greater from the method of disposal of the kitchen slops than from ordinary sewage.

Yet, if properly applied, quite a small piece of ground of fairly light porous soil would be sufficient to treat properly, and safely dispose of foul water of this description. Mr. Rogers Field calculated that about 120 yards superficial would suffice for the treatment of the entire sewage of an ordinary cottage; but the difficulty lies in maintaining proper care and intelligent use of any such an arrangement.

Disposal Tank.

A method of direct irrigation or application to the ground of such slops as they are produced is apt to lead to a too partial treatment of small areas owing to neglect or the consideration of growing crops. A better way appears to be the employment of brick-built and cement-lined water-tight tanks, in which the liquid may be collected, to be applied to the ground by hand in the ordinary course of cultivation.

If all rain-water and washings from yards and pavements are excluded, the daily production of fouled water from a country house may be calculated at about 10 gallons per day for each person, or 70 to 100 gallons per day for a house of medium size. A tank measuring internally 5 feet long, 5 feet wide, and 4 feet deep, would hold about one week's production. If the tank is arranged as shown in the sketch on p. 57, constructed of two chambers of the above size, the first will act as a sedimentation or precipitation chamber, in which the particles in suspension will be broken up and to a large extent destroyed, while the second chamber will serve as a distributing tank from which the liquid may be pumped or dipped, as required for watering or manurial purposes.

The situation of the tank at some little distance from the house is desirable, owing to the necessity for ventilation in order to get rid of the gases arising from the contents of the collecting tank, and very careful construction of the chambers is necessary to prevent chance of soakage into the surrounding soil. If the brickwork is built in cement and sand, and the whole of the interior, sides and bottom, is plastered with the same composition, a perfectly sound job should result.

An installation such as this might be situated in or near the kitchen garden, where it should be a valuable aid to cultivation; and if drawn upon pretty frequently it should be easily managed, and would not be offensive. The precipitation chamber would seldom require cleaning out,

but the water level in the distributing chamber must, of course, be kept down by frequent drawing on its contents.

Dr. Poore's Method. As an alternative to the use of the distributing chamber, the water from the precipitation tank may be discharged into a filter trench, constructed in a manner similar to that suggested by Dr. G. V. Poore, provided that the water-supply is not drawn from wells or ponds in the immediate vicinity. This is done by digging a trench about 3 feet deep, 2 feet wide, and 10 feet to 20 feet in length. The sides and ends of the trench are lined with bricks spaced horizontally 1 inch apart, and the perpendicular joints left dry—that is unjointed with cement or mortar. The walls are carried up to within 1 foot of the surface and the trench filled with small broken brick, tile, or slate packed closely in; on the top of this, from wall to wall, perforated pottery tiles are laid end to end along the whole length of the trench. The discharge pipe from the tank is brought in on the top of these tiles.

Suitable tiles for this purpose are those used for malt kiln floors; but if these are not available it should not be difficult to obtain similar tiles made to suit the purpose. The perforations should not be more than the bare eighth of an inch in diameter.

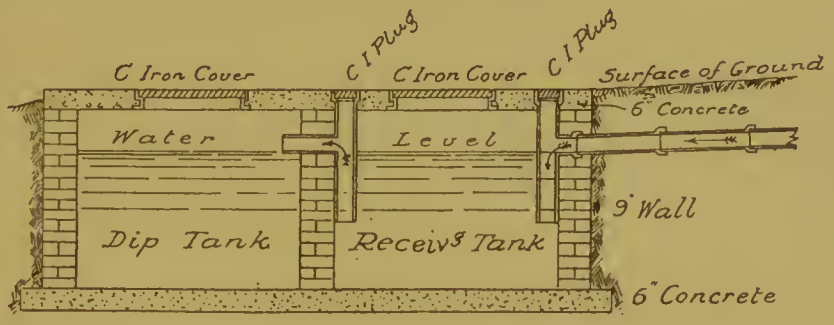
The walls of the trench are carried up from the tiling to the surface of the ground to retain the earth sides, and the top may be covered in with a rough grating of wood or wattle.

The filter will, of course, require occasional attention in keeping the tiles free from fallen leaves and growing weeds, and its position should be as far from the house as can be conveniently arranged. Dr. Poore suggests that a suitable situation would be in a bank thickly planted on each side with privet. Both situation and arrangement depend, of course, upon the position and nature of the source of water-supply, the nature of the soil, surface levels, etc. Several sites suggest themselves, such as along the side of a hedgerow or a belt of trees, in a shrubbery, etc., the filter being on the higher side and in a position that gets a fair amount of air and sunshine and which is not unnaturally damp.

Middens. The removal of the midden privy from the precincts of the dwelling admits of no delay, and the unnecessarily large accommodation for filth should be replaced by some more reasonable form and arrangement, which would be no more costly in construction, much easier to control, and devoid of the unpleasantness and danger of the time-honoured type. The waste products deposited in such receptacles may be rendered almost innocuous by judicious admixture

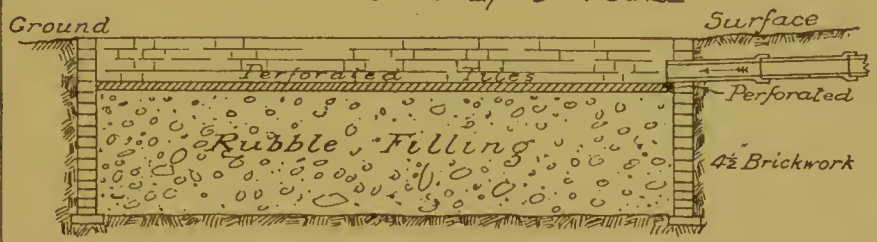
Disposal of Sewage from Country Houses

Sewage Tank contents of which may be used for garden

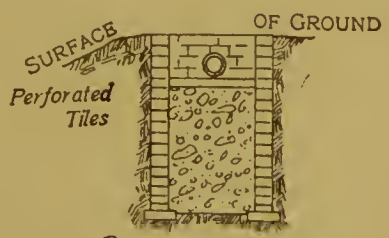


Section through Tanks.

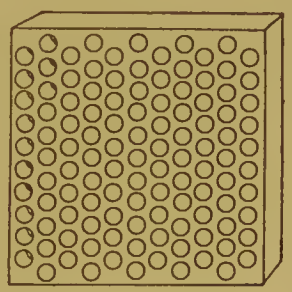
Method of disposal of Sink Wastes suggested by D^r Poore



Longitudinal Section of Trench



Cross Section of Trench



Perforated Tile

with dry earth, sand, or ashes, and their periodic removal will be unattended by the evil odours common to the operation where the old pits are used.

The construction of shallow midden pits at some distance from the house, cement-lined to prevent soakage, and raised slightly above the level of the ground to facilitate emptying, have been recommended for rural districts; but, although these may be well constructed and even arranged so that ashes or dry earth may be occasionally thrown over the soil, the method is too crude and insanitary to merit serious consideration where other and better methods may be as easily adopted.

An accumulation of months, or even weeks, of decaying filth is bound to become objectionable, and the larger the receptacle the more likelihood of neglect in the disposal of its contents at the proper time, and the more chance of overflowing and fouling of the surrounding ground by soakage or careless removal.

Earth-closet.

The earth-closet is not so widely known and adopted as it deserves to be. The chief objections to its use are the difficulty of procuring and storing dry earth at all seasons of the year, and the trouble of frequent removal of the soil.

With regard to the first objection, although fine dry earth is the best deodoriser, other materials may be used when this fails, such as fine dry sand, the fine ashes from the hearth, sawdust, etc. These materials may be stored in any convenient shed or outhouse for use. As for the second objection, a weekly, or even daily, removal of matter possessing considerable value as a manure should not present any very great difficulty, especially in rural districts, where such a device is most needed. The possession of a fairly large garden, in which it may be utilised or buried, or the neighbourhood of arable land, would render its disposal merely a question of arrangement.

Every benefit has to be purchased at the price of some exertion, and surely a little trouble with such an important object as the health of the home in view should not be grudged.

Position of Earth-closet.

Unless there is assurance of adequate attention, the earth-closet should not be placed within the house, but in an annexe or shed with ample facilities for good through ventilation and with the door opening into the outer air. If a special shed or apartment is built for the purpose, quite simple construction is all that is necessary, the essential requirements being a smooth concrete floor, the usual seat and riser to screen the receptacle, a non-absorbent vessel for the reception of the soil, and a provision for flushing or throwing an adequate quantity of deodorising material into

the vessel to cover the soil each time the closet is used. The shed may be constructed of wood, and lined, if desired, with "Uralite" or "Eternite" sheets, which can be treated with Hall's Distemper.

Receptacles. It is desirable to provide two receptacles, so that one may be in use while the other is away for emptying, cleaning, or painting. Iron pails of the desired form may be procured through the ironmonger, and loose-fitting covers of non-absorbent material could be obtained for use when conveying away the full receptacles.

The seat riser may be hinged for the removal of the receptacle, or a door constructed at the back of the enclosure for the purpose. The whole of the sides of the space beneath the seat, including the door, would be better if neatly lined with "Uralite" or "Eternite" to facilitate cleaning; but possibly a better way is to form the enclosure with $4\frac{1}{2}$-inch brickwork, including the seat riser, to plaster the work smoothly with cement and sand, and to have a "Uralite" lined door at the back. This would go far toward getting rid of the faint, unpleasant smell peculiar to earth-closets, which is due in a great measure to the absorption of effluvia by the wood enclosing the receptacle.

Flushing Device. A simple flushing device, with a hopper for earth or sand, may be constructed, as shown in the sketch on p. 61, of wood or zinc to discharge the required quantity of material at each flush, the delivery into the receptacle being directed by a metal deflecting plate at the bottom of the tube, fixed at such an angle that the earth is effectively spread over the excreta. Two pounds of dry earth, sand, or ashes should be sufficient for each flush.

Moule's Closet. "Moule's Earth-closet" is a complete fitting with an earth hopper and flushing arrangement, either of an automatic character, actuated by a slight movement of the seat, independent of the will of the user, or by a pull lever attached to the delivery valve of the hopper. The appliance as purchased requires very little fixing. It should be particularly noted that the efficiency of all earth-closets depends on the necessary attention being given to them. Slops of any kind must not be emptied into the receptacle. The drier the contents of this vessel the less chance there is of unpleasant smells.

Abolition of Privy. The utmost care is needed when abolishing an old privy pit or midden to ensure the complete removal of all soil, and even structural parts of the contrivance, which by reason of long contact with the filth are likely to prove a source of contamination. Especially is this necessary when the pit is close to or

actually within the house, as is sometimes the case. Generally, the brickwork is saturated and rotten with the soakage of years, the mortar joints decayed, and the bricks practically bedded in soil. The floor, if not actually rotten, is foul with splashings and emanations, and the seat and riser are, of course, filthy. It is therefore most necessary to clear away every portion of such soiled material.

The pit must be filled up with fresh light earth or mortar rubbish, rammed well down, and the surface prepared for a new flooring of cement concrete; but care must be exercised, as the filling is liable to subsidence or shrinkage for some time, and the fixing of a water-closet on such a foundation often results in broken connections and much trouble subsequently.

Cesspools. Drainage into cesspools or dumb wells sunk into the earth is a method of disposal largely adopted in many districts, and in absorbent soils this would appear, when considered casually, to be a highly satisfactory way out of the difficulty. But where the water for domestic use is drawn from wells sunk in or through the same stratum into which the refuse is discharged, and often at a point not far distant from the cesspool, there is always very real danger to life. Thus a practice may bear an economical aspect at first sight, but sooner or later its extravagance becomes manifest in its baleful effect upon the health of the community.

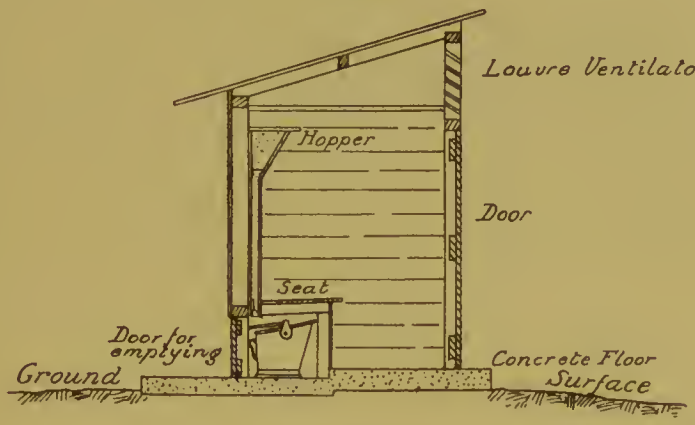
Principles of Drainage. The broad principles of modern house drainage as laid down by Sir Douglas Galton are perhaps the best exposition in brief that can be selected:—

> "1. The immediate and complete removal from the house of all foul and effete matter *directly* it is produced.
>
> "2. The prevention of any back current of foul air into the house through the pipes or drains which are used for removing the foul matter."

The statement is simple, but the accomplishment of the fact is a great deal more difficult than one would imagine, owing in part to indifferent workmanship, faulty fittings, and a general lack of knowledge on the part of the user, which leads to careless treatment and abuse of the appliances provided for this purpose.

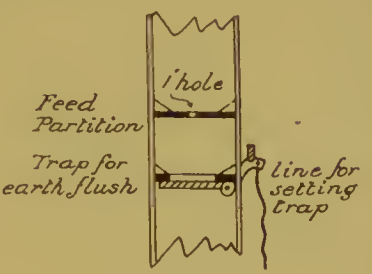
To effect the speedy removal of foul matter in the manner desired, the house must be provided with various properly constructed fittings, such as water-closets fitted with means of flushing or sweeping away the effete matter deposited in the basin, by the action of water; slop sinks to receive water fouled by the manifold operations of the house-

SUITABLE ARRANGEMENT FOR EARTH CLOSET



Section through Earth Closet

SUGGESTION FOR EARTH FLUSHING DEVICE



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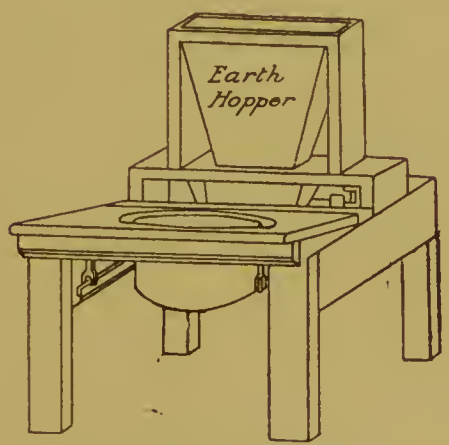


Moules Earth Closet with seat action

Side View

hold; and baths for the cleansing or removal of superficial impurities from the body, and each of these should have its own outlet suitably connected to a system of water-tight drains.

To prevent a back flow of foul air through these outlets from the drains, traps or water-sealed devices are attached to or form part of each receptacle or outlet, and ventilating pipes are carried off at suitable points for the escape of foul gases given off from the effete matter passing through the drains.

It is not going too far to state that nine householders out of ten have but a very vague notion of the principles or structure of the fittings they use; otherwise we should not hear so much of those troubles which can only arise from the gross misuse of drainage conveniences.

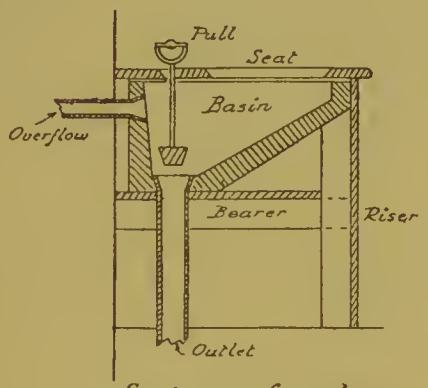
It is imperative that all waste-pipes, whether from w.c., slop sink, or bath, should be carried into the outer air immediately upon leaving the fitting—that is to say, all fittings should be fixed against an outside wall, so that the shortest possible length of waste-pipe is contained in the house; the reason for this is obvious.

Foul Gases. All waste-pipes become coated to some extent with decaying particles of the wastes flowing through them, from which gases are evolved, and the slightest defect in pipes or pipe joints may lead to the escape of these gases into the house. Then, again, such a length of pipe cannot be conveniently ventilated, and it becomes filled with foul gases, which bubble up through the water in adjacent traps, or the water in the traps absorbs the gases to such a degree that they are readily given off as soon as the temperature of the water is raised, as it is bound to be when exposed for a long time to the warm temperature of the house. This fact may be proved by attaching an india-rubber tube to a turned-on gas jet and placing the other end in a vessel of water for a few seconds. The water will smell strongly of gas when the tube is removed, but if the liquid is warmed the smell becomes stronger, as the expanding water particles liberate more freely the imprisoned gas.

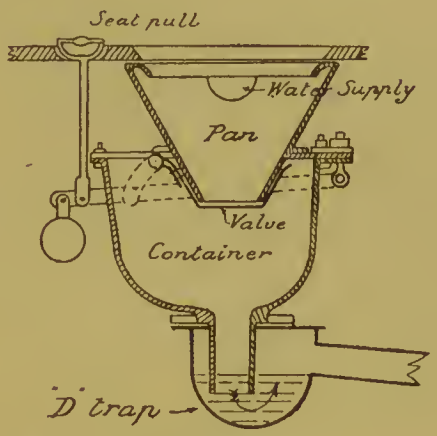
Water-closet. It is said that the water-closet has been a source of trouble ever since its invention, but much the same may truthfully be said of any other convenience appertaining to house drainage, chiefly because studied attention to such details is so often regarded with an amount of foolish repugnance which leads many people to consider that the less that is known of such objectionable necessities the better.

The modern water-closet is made to such perfection and at such

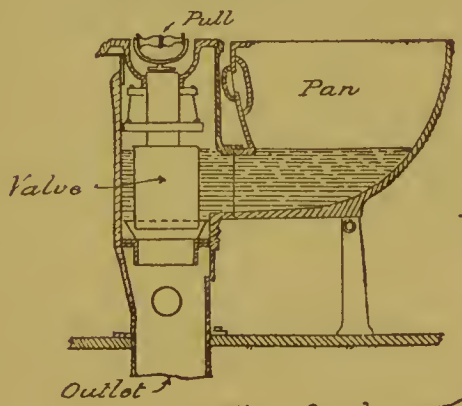
UNDESIRABLE FORMS OF WATER CLOSETS



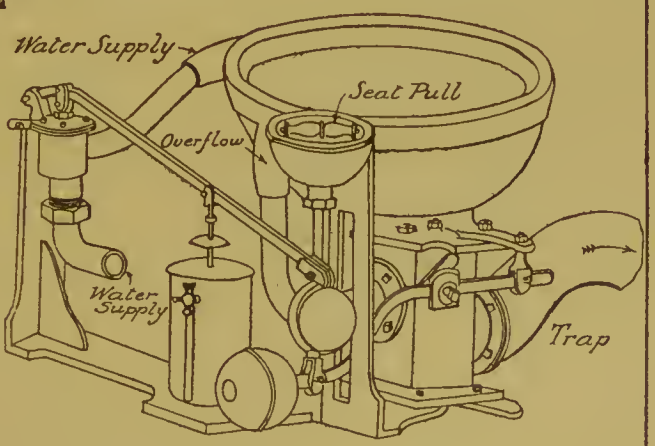
Section of early form of W.C



Section of Pan Closet.



VALVE CLOSETS



a price that it should be possible for every decent house to be equipped in the best possible manner. Yet one frequently meets with antiquated and unsafe contrivances even in better-class houses, which are a constant trouble and expense and are responsible for an incalculable amount of ill-health and annoyance. Some are survivals of very early date, the inventions of the eighteenth and early nineteenth centuries, but still they do duty here and there.

The earlier type consists simply of a basin with a metal plug fitted into the top of the soil-pipe, or a valve closing against the outlet, which is actuated by a handle fixed through the seat. A supply of water is fed in at the top of the basin, which ordinarily stands half full and forms a water-seal, if the plug or valve is in good working order. This type is now somewhat of a rarity, but may be occasionally met with.

The Pan-closet.

A later type is of more frequent occurrence, as up to quite recent times it was largely fitted and is yet on the market. This is known as the "pan"-closet. It consists of a pan or basin set upon an iron box or container, in which the valve that closes the outlet of the pan works. The container usually discharges into a water-sealed trap of lead known as a "D" trap, but sometimes this trap is absent. Water is laid on direct to the pan, as in the former type, and the outlet valve and water-flush is worked by a system of levers attached to a pull handle fitted in the seat.

The faults in the foregoing types are many and grave, the chief among them being an insufficient flush to carry away the sewage through the trap or to cleanse the basin, and the direct communication of the water-service with the basin creating a danger of polluting the water-supply by insuction of filth, when the water-pipes are emptied and air is drawn in.

With the first-mentioned type there is no permanent water-seal, and each time the plug is withdrawn or the valve opened a whiff of foul air is allowed to escape from the soil-pipe into the house, and with the second form the container beneath the pan becomes coated internally with a filthy decaying slime, and the foul gases from this are actually pumped up through the outlet of the pan at each pull of the lever.

Other forms of valve-closets which are still extant are illustrated on p. 63 to show the elaborate machinery required for their working, the insecurity of the water-seal, or the extent of internal surfaces and parts liable to fouling which are inaccessible for cleaning.

EARTHENWARE WASH-DOWN PEDESTAL W.C., WITH EARTHENWARE CISTERN

FIRECLAY WASH-OUT PEDESTAL W.C., WITH "INSERTA" WOOD RIM, CHAIN PULL COVERED UP IN METAL TUBE.

TYPES OF MODERN WATER CLOSETS

Hopper W.C.

The old stoneware long hopper pan is sometimes to be found fitted with a similar arrangement for water-flushing as described above, known as a stool-valve—that is, where the service-pipe is carried directly to the pan without the interposition of a cistern; or if a cistern exists it is usually one from which water is drawn for other domestic uses. Here we have another source of danger, for the water in the cistern is exposed to gases, arising by way of the flushing-pipe from the water-closet, which it readily absorbs.

CHAPTER VIII

INTERIOR FITTINGS AND CONNECTIONS

"Whate'er is best administer'd is best:"—POPE.

THE introduction of glazed stoneware marked a decided epoch in the history of house drainage, and made it possible to perfect, at a reasonable cost, many forms of sanitary appliances. These are now made in such a variety of designs that a choice is a matter of difficulty unless one is armed with some knowledge as to what is desirable, and this is especially true with regard to the water-closet.

Long Hopper Pans.

The long hopper pan still retains the favour of many a jobbing builder, who encloses the contrivance in a wooden box formed by the seat and riser, and provides a flushing arrangement wholly insufficient for the purpose for which it is intended. Stoppages of the outlet are therefore of frequent occurrence, and the hopper soon becomes coated with hardened filth, the residue of numerous deposits which the meagre flush has failed to remove.

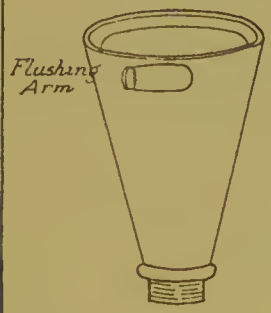
This hopper is of the form of a long cone or funnel, and is set on a separately made trap as a base. The hopper is often merely stood upon the trap, and the joint is quite innocent of any filling material to prevent leakage should the trap become choked and the liquid rise above the joint.

A slight improvement upon the foregoing type is the short hopper, which is designed for better flushing facilities, but it is provided with a separate trap of the form described above, and the joint, which is hidden from view by the seat and riser, may be the cause of much annoyance and, indeed, serious trouble by leakage and the consequent accumulation of filth within the enclosure.

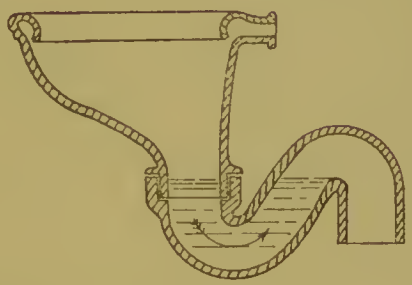
Pedestal W.C.

By the use of the "pedestal" water-closet, in which the whole fitting, pan, and trap is made in one piece, it is possible to abolish this method of enclosing the fitting and to have the joints with soil-pipe and flushing-pipe exposed to view, so that a leak may be at once detected. Moreover, it does away with a dangerous dust trap and a hiding-place for spiders and other objection-

UNDESIRABLE FORMS OF W.C. PANS



Long hopper pan



Short hopper and trap

EXAMPLES OF
MISAPPLIED DECORATION.

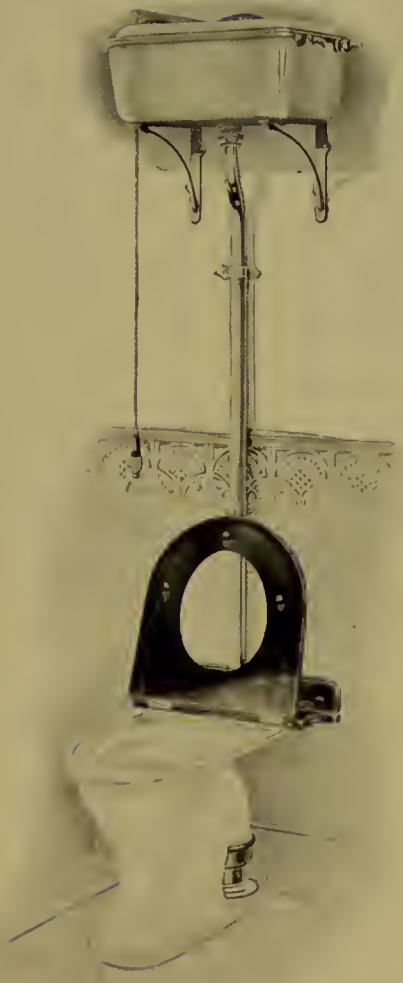
able creatures, formed by the seat and riser. Such an appliance may now be fitted up at a very little above the cost of the old arrangement, and can be obtained in a specially heavy make to resist rough usage.

The seat should be hinged so that it can be raised when slops are thrown into the basin, or the water-closet can be obtained with inset wood rims to the pan, so that the seat, as generally known, is not required. There are two types of "pedestal" water-closet—the "wash-out" and the "wash-down." In the former the basin is distinct from the trap, and holds a small quantity of water intended to receive the excrement, which is swept out by the water-flush into the trap. The objections to this form are the insufficiency of water contained in the basin to cover the deposited filth, and the failure of once flushing to cleanse the basin thoroughly, and to carry the excreta through the trap, the force of the water being chiefly expended in scouring the basin.

With the wash-down type, in which the basin and trap are intimately constructed, there is a sufficient quantity of water retained in the basin to receive and immerse the deposit, and the whole force of the flush is directed upon the contents of the trap.

Valve-closet. The valve-closet is made in various forms by some of the best makers; but, generally speaking, the simple wash-down pedestal closet is to be preferred. The valve-closet, however, is largely used in the better-class houses, chiefly on account of its silent working; but most of these are open to some of the objections set against their prototypes—viz.: the direct connection of the supply valve to the basin, the absence of a constant water-seal for the area liable to soiling in the valve chamber, above the water line; or the somewhat complicated system of levers which is characteristic of the type. Simplicity is decidedly an advantage, especially when the fitting is exposed to rough or careless usage; the less machinery we have in connection with the water-closet the better.

Expense and Efficiency. Expense is no criterion as to efficiency of service, and it is possible to pay a large price for an elaborate and showy appliance which is less serviceable than a plain and simple one. The ornate decoration of a fitting of this description is, to say the least, incongruous. It is impossible to disguise its purpose, nor is it necessary or desirable to do so. A strong, plain fitting of good form with an imperishable glaze is all that is required—white ware for the better part of the house, and buff, or white and buff, for servants' water-closets. No embellishment will improve upon this, and



WASH-DOWN PEDESTAL W.C., WITH SLOP TOP

PEDESTAL W.C., WITH SELF-LIFTING SEAT, WHICH AUTOMATICALLY DISCHARGES FLUSH

TYPES OF MODERN WATER CLOSETS

it is preferable for the whole of the outside as well as the inside to be perfectly smooth and free from flutings or decoration in relief.

The Best Fittings.

Having arrived at this point, the choice of the water-closet becomes a thought more simple, and we can consider those points which make all the difference in the service of the fitting. The basin should be of the short hopper form, and should hold sufficient water for the immersion of the excreta, which must drop clear of any portion of the basin uncovered by water. The trap should have a deep water-seal, and one flush should be sufficient to sweep away all deposit from the pan and trap. A broad base is desirable for stability, and the whole fitting should be of a heavy make rather than of graceful outline, as efficient service is the point to be gained even at the expense of appearance.

As the object should be to discharge the sewage from the house as directly as possible, the best form of outlet to the basin for a water-closet above the ground level is what is known as a "P" trap, which requires the fitting to be placed against an external wall, and leaves the shortest possible length of soil-pipe within the house. The "S" trap is not so good, and the pedestal, with an outlet in the centre of the base, should not be chosen, on account of the difficulty in making a reliable joint with the branch of the soil-pipe.

The branch from water-closet to soil-pipe should be either of lead or cast-iron. If of lead it should be what is known as "drawn lead" pipe, not a tube made out of sheet lead with a longitudinal lap or joint. The joint between water-closet and branch should be open to view, and on no account built within the wall or buried in plaster, where leakage of water or sewer gas would probably remain unnoticed for some time.

Soil-pipes.

Soil-pipes are made of cast-iron or drawn lead, and should be 4 inches in diameter internally. In lead pipes the joints are wiped, or joined by a large bulb of solder extending all round and some inches above and below the joint. When of iron, the pipes should be of a heavy pattern, with sockets suitable for making a run lead or hot metal joint, which is afterwards caulked or tamped down solid and gas-tight.

The soil-pipe is carried up or extended to the top of the building and the end left open to allow a free escape for sewer gas, which might otherwise be absorbed by the water lying in the water-closet traps, or actually bubble up through the water into the house. Water-closets on the ground level have usually the "S" trap and are connected by stoneware pipes to the drains.

Flushing Cisterns. Many water-closet cisterns are in use which are practically useless for flushing purposes, and these are still made and fitted in large numbers, while most of the more trustworthy in point of efficiency are extremely noisy in action, and are therefore sometimes rejected in favour of less useful patterns.

The genus may be divided into two types—the valve cistern and the syphonic cistern. The valve cistern is discharged by the removal, by means of a pull and lever, of a plug or valve closing the outlet into a flushing-pipe, and the amount of water delivered into the water-closet basin depends upon the duration of the pull, or, in other words, the flush lasts until the handle is released. With the syphonic cistern, a pull starts the action of the syphon and the whole contents of the cistern are delivered in a continuous stream.

In the first case the usually hurried snatch at the pull results in a small discharge quite inadequate to effect the work required, and, as some water is discharged, the purpose of the puller has been accomplished, and he is satisfied. The basin and trap are consequently always foul with undischarged filth, and become coated in a short time with excreta. But the syphon, when started, cannot fail to deliver the whole of the cistern's contents.

The noise of refilling may be governed, to a great extent, by the regulation of the force of the supply by partially closing the stop-cock, which should always be fitted to the supply-pipe. It is seldom that the appliance is used in rapid succession by several persons, so that the extra time taken in filling is of no consequence. In some makes of "noiseless" cisterns the feed-pipe is carried well down into the tank. Methods of fixing often accentuate the noise trouble, and it is no uncommon thing to find the cistern affixed to a matchboard partition or a thin lath-and-plaster wall, which forms a veritable drumhead.

The cistern should be fixed well above the basin, as the efficiency of the flush depends in a great measure upon the fall. The fall-pipe should be of lead 1½ inches in diameter; bends or angles should be avoided, and the pipe carried directly down to the basin.

Slop Sinks. Slop sinks, whether in the scullery, kitchen, pantry, or fixed on the upper floors for the housemaid's use, should be situated as near to an outside wall as possible, and close to or under a window. The waste-pipe should be of lead 1½ inches to 2 inches in diameter, closed at the top by a brass grating soldered on to the mouth of the waste-pipe, and should

No. 1

No. 2

No. 3

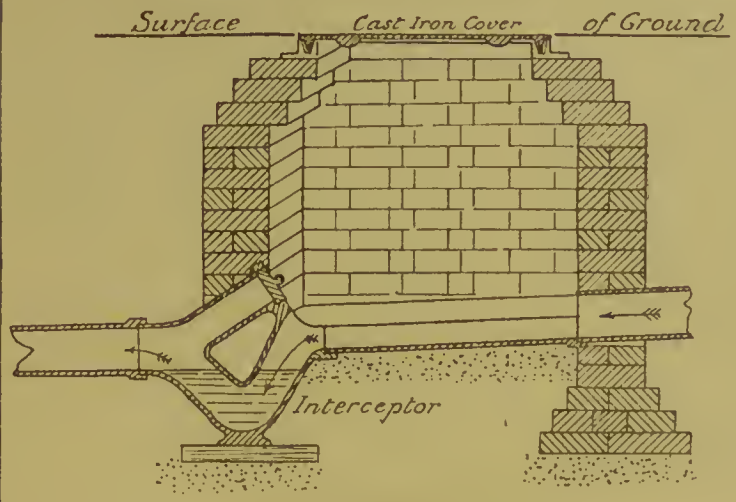
No. 4

No. 5

No. 1. GLAZED EARTHENWARE
,, 2. GLAZED EARTHENWARE
,, 3. POLISHED MAHOGANY, COPPER LINED
,, 4. DECORATED GLAZED WARE
,, 5. CAST-IRON. FINISHED WITH VITREOUS ENAMEL

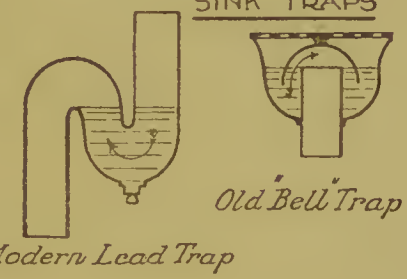
THE LIDS IN ALL CASES ARE OF IRON, PAINTED OR ENAMELLED AS DESIRED

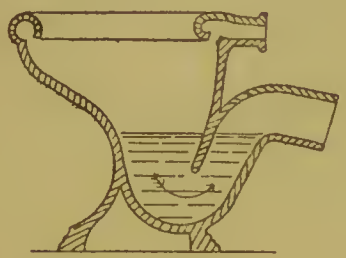
W.C. FLUSHING CISTERNS MAY BE OF GLAZED FIRECLAY. STONEWARE, POLISHED WOOD, OR METAL



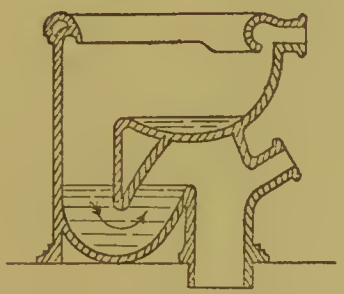
INTERCEPTING PIT

SINK TRAPS

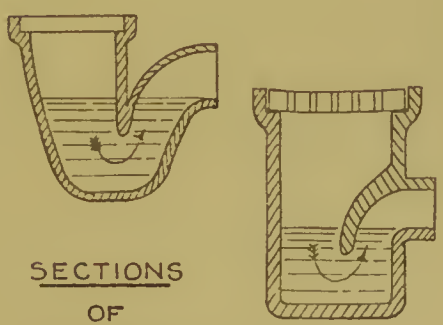




SECTION OF
WASH-DOWN W.C



SECTION OF
WASH-OUT W.C.



SECTIONS
OF
WASTE WATER GULLIES

be fitted with a lead trap in the waste-pipe immediately underneath the sink.

The trap should have a screwed plug for cleaning, but this operation will not be needed, except at long intervals, as the existence of the fixed grating will prevent the entry of substances liable to choke the trap.

The old stone slop sink, with its open waste-pipe, often 3 inches to 4 inches in diameter, is altogether a filthy contrivance. In the first place the stone is of an absorbent nature, and in time becomes pitted with small holes, which render cleaning difficult. Then the large waste-pipe becomes coated internally with decaying fatty matters from culinary slops and soapy water, and the air which at times is drawn into the house through this channel is polluted by gases absorbed from this coating.

True, the mouth of the sink outlet may be guarded by a bell trap, but this is a very poor safeguard, as the water-seal is inconsiderable and the bell is often chipped or broken, and then the seal is entirely gone. It is also customary to remove the bell altogether while the sink is in use, to enable the water to get away more quickly, so that the pipe is frequently discharging contaminated air into the house for hours together.

Objections to the lead trap are entirely fanciful. The flow through a 1½-inch trap is much greater than through an ordinary bell trap, even when the bell is removed, as the outlet in the latter case is seldom more than 1 inch in diameter. A larger waste-pipe than 1 inch is therefore quite unnecessary where the bell trap is used, whereas the lead trap is throughout the full bore of the waste-pipe. Choking of the trap seldom occurs if the grating is fixed over the outlet so that it cannot be removed.

If sand is used for scouring and is washed away down the pipe, trouble may arise, but even this difficulty is soon surmounted by unscrewing the plug of the trap and allowing the contents to drop into a bucket placed beneath. Hot salt water occasionally poured down the pipe will remove all grease, which may collect in the trap.

Stoneware Sinks.

Glazed stoneware sinks are really the cheapest, most sanitary, and best for all purposes for which such appliances are needed, except perhaps for the butler's pantry, where silver and glass is washed, and there the lead-lined wood sink will still survive as being less productive of mishaps to such ware than the more unyielding stoneware; but the housemaid's sink should certainly be of the more sanitary material.

FIRECLAY SINK ON FIRECLAY PEDESTALS WITH "INSERTA" WOOD EDGE AND TEAK DRAINING BOARD

FIRECLAY SINK CARRIED ON IRON OR FIRECLAY BRACKETS

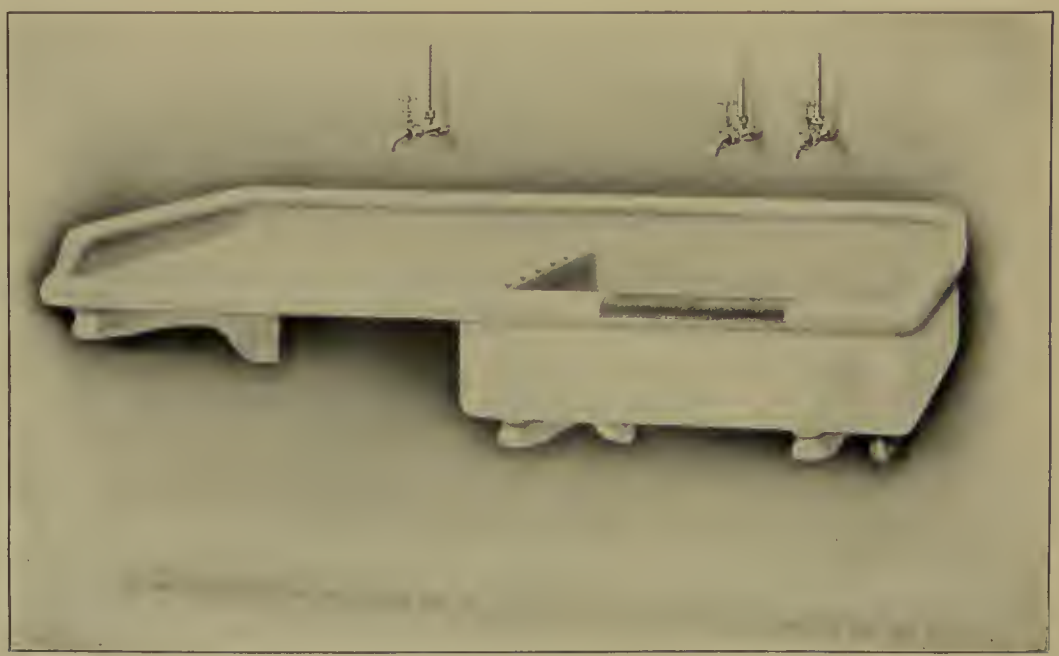
FIRECLAY SINK WITH FIRECLAY DRAINING SLAB IN ONE PIECE

SLOP HOPPER WITH "INSERTA" WOOD RIM AND BRASS BUCKET GRATING

SLOP SINK AND HOPPER

TYPES OF MODERN SLOP SINKS AND CLOSETS

SLOP SINK OF GLAZED WARE, SUPPORTED BY LEGS OF SIMILAR MATERIAL, WITH TEAK DRAINING-BOARDS

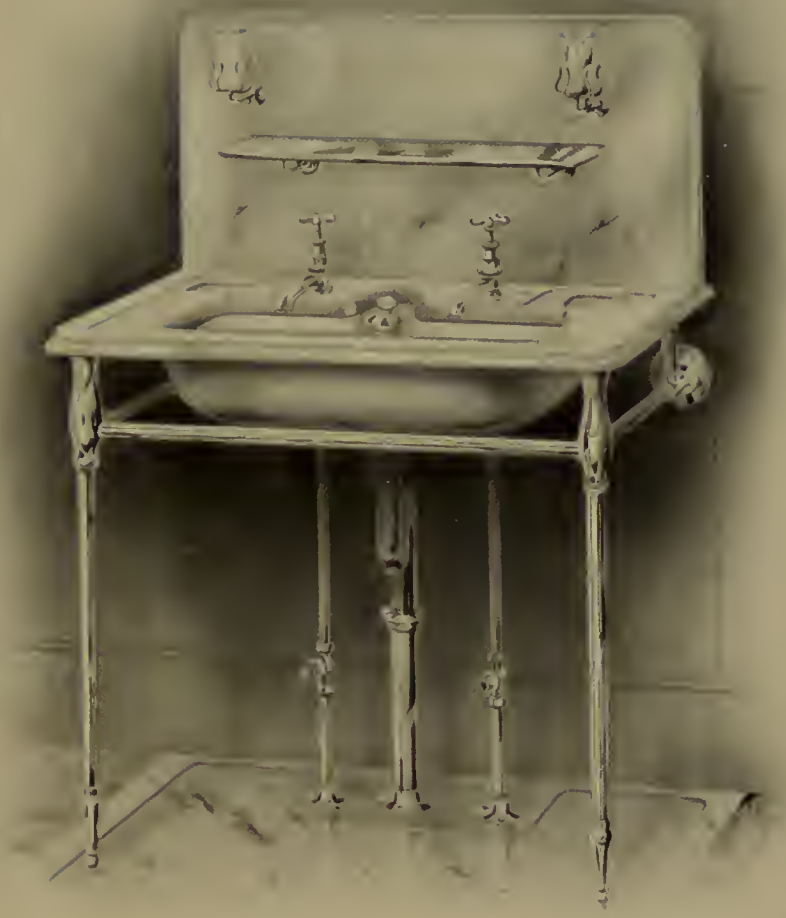


SLOP SINK AND DRAINING-SLAB OF GLAZED STONEWARE ON STONEWARE WALL-BRACKETS

GLAZED WARE BASIN SUPPORTED ON BRACKETS, OF SAME MATERIAL BUILT INTO WALL

GLAZED WARE LAVATORY BASIN, SHOWING HOT AND COLD WATER SUPPLY AND TRAPPED WASTE PIPE

MODERN LAVATORY FITTINGS



MARBLE LAVATORY ON GUN METAL STAND, SHOWING NEATLY FINISHED SUPPLY PIPES AND WASTE-WATER OUTLET PIPE

MODERN LAVATORY FITTING

Lavatory Basins.

Lavatory basins need quite as much care in the fitting as does the slop sink, and their position should be carefully chosen with regard to light and the immediate discharge of the waste from within the house. It may be said that, considering the waste consists of only soapy water, there can be no danger or annoyance from such a source; but contained in this water are particles of human skin and organic products from the body which, with the soapy particles, coat the inside of the waste-pipe or clog the overflow and become extremely offensive in decay. Therefore, careful trapping of the waste-pipe is required to prevent an indraught of contaminated air.

A fixed basin of glazed stoneware or porcelain is the best possible form, as usually the basin and top are in one piece and of simple construction. The tip-up basin is not to be preferred, as the container or chamber in which the basin swings is soon coated with a hardened deposit from the dirty water and seldom receives the cleaning which is required to keep it free from this offensive accumulation. Every basin should have an overflow-pipe, which must be connected with the waste-pipe between the basin and the lead trap.

One very common fault is a too small overflow which soon becomes choked by floating scum, especially where the escape from the basin into the pipe is represented by a number of tiny holes. Soap and brush trays should be drained into the basin by means of a groove or channel and not by small pipes carried into the waste-pipe.

It is a usual thing to box in the space beneath sinks and lavatory basins to form cupboards. The custom probably serves the purpose of hiding the unsightly and careless work of the plumber, but it also provides an abiding-place for undesirables and a receptacle for filth. The plumbing, if intended to be exposed to view, is likely to be more neatly executed, and need not present an unsightly appearance. At any rate, it is very desirable that all fittings of this sort should be open to observation.

Sinks and lavatory basins may be supported upon cast-iron stands or brackets, which are made for this purpose, and are either painted or coated with a burnt-in vitreous enamel; but a still neater finish is presented if they are carried on glazed fire-clay or earthenware pedestals.

The scullery sink may be supported on built-up piers of glazed bull-nosed bricks of white or buff colour to tone with the colour of the stoneware, and if the walls of the apartment are finished in the usual plaster the space beneath and over the sink and a 9 inches

wide margin at the sides may be similarly treated or covered with tiles.

It is very desirable that the surrounds of such appliances, liable as they are to splashings of foul liquids, should be easily and effectually cleaned, and for this reason slop hoppers, slop sinks, and lavatory basins are made with high backs, to prevent as much as possible the soiling or soakage of absorbent plaster or woodwork.

Baths. Baths are made of a variety of materials, from the heavy glazed fire-clay article to the thin sheet-metal appliance of tin, copper, zinc, or steel, or tank-like constructions of slate, wood, or lead. The bath commonly met with is of cast-iron with an enamel painted surface, but a better class of bath is finished with a burnt-in porcelain enamel of a durable character. Such a cast-iron bath is the cheapest and most suitable for home use, and can be now obtained of such a presentable form and finish that the insanitary wood casing so often used to hide an ugly exterior is entirely superfluous.

The bath should be placed so that it is possible to clean all round it, and it is perhaps needless to say that the waste-pipe must be trapped and conducted out of the house by the shortest possible route, the overflow being connected with the waste-pipe on the bath side of the trap. The inlet for hot and cold water must be quite separate from the outlet or waste pipe, and not arranged as in many of the older types, where the three pipes are gathered to one general duct, which, although perhaps of no great length, is alternately fouled by the outgoing waste and cleansed by the incoming supply of fresh water.

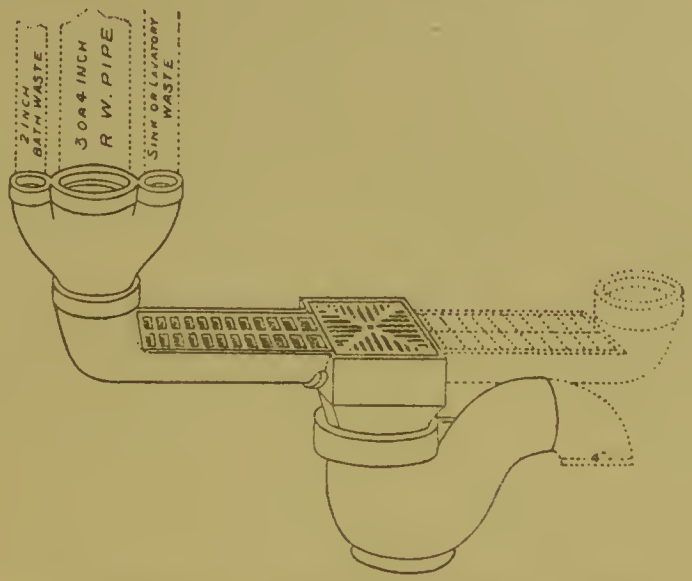
Waste-pipes. All waste-water pipes from the house must discharge on to trapped stoneware gullies fixed in the open air; or, better still, into a stoneware channel or slipper leading to the gully, the point of discharge being about 1 foot away from the gully.

Gullies. Gullies are sometimes fixed with inlets between the water level and the grid into which the waste-pipe is conducted, but these are not to be preferred, on account of the gases arising from the fouled water in the trap, or actually ascending through it from the drain when under gas pressure. This is perhaps not a matter of much importance when it relates to the waste-pipes from the ground floor which are properly trapped, but the pipes from the bath and lavatories on the upper floors are, or should be, disconnected immediately they emerge into the outer air by discharging into a hopper head, from which a pipe descends to the gully beneath. This hopper head is frequently very near window openings, into which the ascending gas from the gully may be carried.

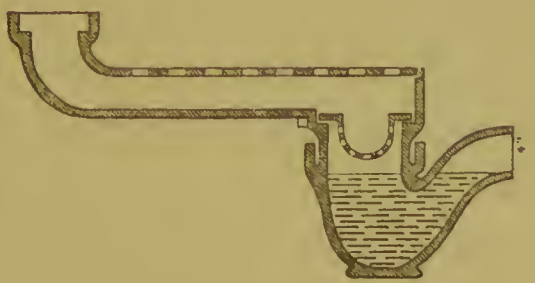
CHILDREN'S BATH IN ENAMELLED CAST-IRON ON GLAZED STONEWARE LEGS

CAST-IRON BATH FINISHED WITH VITREOUS ENAMEL, SHOWING HOT AND COLD WATER PIPES AND WASTE-PIPE

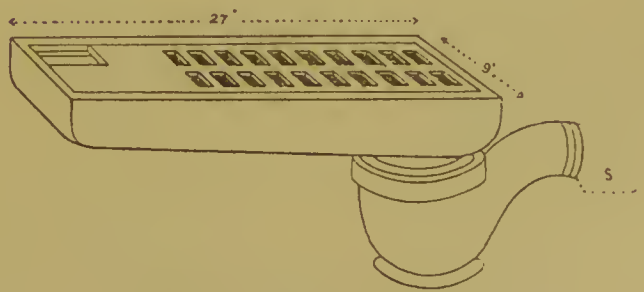
TYPES OF BATHS



SLIPPER FOR RECEIVING WASTE WATER



SECTION THROUGH SLIPPER & GULLY



MODIFIED FORM OF SLIPPER

There is, however, one great advantage in the use of the gully with the inlet below the grid, in that the unpleasant appearance of an accumulation of stranded scraps scattered over the top of the gully, and the annoyance of those periodic overflowings caused by a choked grating, are avoided. An alternative which combines in some measure the advantages of the side inlet and the open channel is possible by the use of the slipper shown in the illustrations on p. 75.

No gully should be allowed within the house or in any conservatory, greenhouse, shed, or enclosed area where a free circulation of air is impossible, as the water contained in the trap is always foul and often highly charged with gases absorbed from the drain. Also, decaying organic matter is always clinging to the sides of the gully and to the grating, from which effluvia is constantly arising.

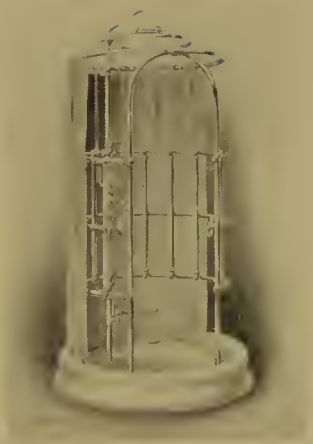
Drains. The drains which convey the wastes from the precincts of the house to the sewers are laid with glazed stoneware pipes, jointed together with cement. The various branches from water-closet gullies, etc., are usually collected or brought together into manholes or inspection pits, or connected to the main line of drain by junction-pipes inserted at suitable intervals. Before reaching the sewer the drain passes through an intercepting trap designed to prevent a back flow of foul air from the sewer. When the drain is a long one or the branches extend over a considerable area, inspection pits or access chambers are built at suitable points to enable the drains to be cleared by means of drain rods in the event of stoppage or obstruction to the outflow. It is the growing custom to employ the pipe junction as little as possible, and to carry each branch where practicable to an inspection pit, where easy access may be obtained for rodding the drain.

Ventilation. Ventilating shafts and fresh-air inlets of cast-iron pipe are erected at suitable points to air the drain. The necessity for this has been proved by frequent bacteriological analyses of sewer air, in which it was found that a plentiful dilution with fresh air caused a considerable decrease in the number of microbes commonly found therein.

All ventilators should be carried up above the ridge of the roof, away from roof lights or dormer windows, very carefully jointed with hot lead, and covered at the top with a wire cage to prevent the enterprising sparrow from stuffing them with nesting material. If the ventilating pipes are taken up on that side of the house exposed to the greatest amount of sunshine, their efficiency is increased by an induced draught due to the warming influence of the sun.

FIRECLAY SITZ BATH

ENAMELLED CAST-IRON BATH



SHOWER AND SPRAY BATH
WITH FIRECLAY TRAY

CHILD'S BATH ON PAINTED OR ENAMELLED
CAST-IRON SUPPORT

FIRECLAY BATH TUB

TYPES OF MODERN BATHS

Ventilating pipes are for the greater part carried up to an insufficient height above window openings or are badly placed with regard to action of wind, position of chimneys, etc.

The builder economises by taking the shaft up at the nearest possible point, and the architect is anxious to preserve the lines of his design unbroken by a too prominent feature of this sort; consequently, one may often see a ventilator ending but a few feet away from and on the level of a roof light or dormer window, or within a foot or two from a chimney top which may under certain conditions suck in the gases.

In one notable case, that of a beautiful Elizabethan mansion which, unfortunately (from an archæological point of view), had to be drained, the ventilators, of which there were three or four, were carried up the walls facing an enclosed courtyard, and in order to render them as unobtrusive as possible, each ended under the projecting eaves, almost on a level with numerous windows and with many feet of high-pitched roof above them, which protected them from free exposure to winds. Under such circumstances it is not surprising that constant ailment of its inhabitants finally culminated in a serious outbreak of disease.

Air Inlets. Fresh-air inlets should be carried well above the surface, quite remote from doors or windows, and carefully jointed, as in certain states of the atmosphere the flow of air is reversed, the inlet acting as an outlet. This precaution is important, and it is a question worthy of consideration whether the inlet should not be carried up much higher than is usually the practice.

The use of the mica valve on the inlet shaft is to prevent this back flow, but the valve usually fitted is of such poor quality that it is easily deranged, and at the best the device is not proof against the passage of a slow current of air; therefore, its employment is unimportant. The shaft should, however, be protected at the least with a wire cage similar to that used on the outlet ventilator shaft.

Rain-water pipes must not be connected directly to the drains, unless separate drains are laid to a rain-water storage tank; but should be made to discharge into gullies. Neither may such pipes be used as waste-pipes from water-closets, sinks, or lavatories.

Inspection Pits. The manholes and inspection pits are usually covered in with cast-iron covers fitted into a grooved frame, the groove being intended to hold thick grease or mastic composition, into which the tongue or rib of the cover sinks and forms an air-tight joint to prevent the escape of sewer air. The covers must, therefore, be placed securely in position, set level, and kept sealed, except when an examination is required.

Capacity of Drains. Drains are designed to carry away the liquid and semi-liquid wastes from the house and premises, and are not suited or intended for the removal of other refuse matters. Much expense, inconvenience, and danger to health arises from the general inability to grasp this fact, or the perverse carelessness of very many people who persist in attempts to dispose of all sorts of refuse through these channels. From the sketches on p. 71 it will be seen that it is only at the risk of considerable damage that scrubbing-brushes, empty tins, etc., can be induced to disappear through water-closet traps or gullies; but the ingenious lady-help who has inadvertently poured such articles down with the waste or slop water occasionally enforces her demands by a vigorous application of the kitchen poker, or a stout broomstick, and accomplishes the disappearance of the obstruction by breaking out the bottom of the trap. Swabs and cloths are more frequently thrown down, and, to avoid the unpleasant job of fishing them out, every effort is made to get them out of sight with the idea that once out of view they are gone for ever, but such things have an unpleasant knack of reappearing months after, when the choked drain demands attention. A stout wire hook, securely bound upon a stick, is likely to prove a useful tool in such emergencies, to rescue the escaping cloth.

Grease. Hair and grease are responsible for much trouble in the way of choked drains, and numberless instances might be quoted of serious complications arising from the combined agency of these two substances. Every housewife knows how cooling grease will cling to cold surfaces, and she is also aware that it is difficult to wash away hair combings from even smooth surfaces. When such matters are allowed to pass into the drains the hair will cling most tenaciously to the sides of inspection pits and traps, or to rough joints in the pipes; the grease collects around the hair, and a solid mass is soon formed which no amount of flushing and rodding will effectually remove. The only satisfactory way of disposing of waste hair is by burning.

Grease traps and gullies of many forms have been designed with a view to preventing this trouble, but they all require frequent attention and emptying. Nothing is more disagreeable than dealing with the foul decaying mass deposited in such receptacles, and consequently the performance of the task is often avoided or imperfectly performed, and the contrivance becomes an insufferable nuisance. Really, the best way is to avoid the necessity for such traps by dealing with the grease at an earlier stage, and since it has to be handled sooner or

later it is better to do so when fresh than to postpone the operation until it has become putrid. The remedy is simple, and consists in allowing all greasy liquids to get cold before pouring them away; the fat can then be skimmed off and burnt. Scouring sand must not be thrown down or washed into the drains, as it is very difficult to remove by flushing and quickly accumulates in traps and gullies, and in pipes where the flow is in the least degree sluggish.

Foul Smells. To ensure immunity from unpleasant smells and to secure the satisfactory working of all sanitary fittings and appliances cleanliness is essential. The water-closet must be kept clean, the sink and lavatory basin spotless, the gully free from deposited sand or grit, and accumulations of scraps of refuse or dead leaves upon the grating. A bass water-closet brush, which after use should be well rinsed and hung in the air to dry, should be found in every home, and a small iron scoop or ladle should be kept for the purpose of emptying sand, grit, and other heavy matters which flushing has been unable to remove from the gullies.

Such tasks may not be pleasant, but the undeniable fact that the shirking of these small matters often leads to the disorganisation of the drainage, flooding, and other serious annoyances, should be sufficient to ensure their due performance.

Miscellaneous Matters. A wire basket or small perforated bucket, known as a sink tidy, is a useful article for the reception of slops containing tea-leaves and other matters liable to choke the sink outlet. This is hung at a convenient height over the sink, and the contents, when sufficiently drained, may be burned.

A coarse, woven wire pan or sieve, made to fit loosely over the water-closet basin, for use upon such occasions as when cleaning-slops are emptied into it, would be a great safeguard against damage to the pan by the accidental dropping of heavy articles or the entry of cleaning-cloths, scrubbing-brushes, etc. A pailful of clean water poured through it would cleanse it after use, and it could then be hung up upon a convenient nail until required again.

Obstinate stains on lavatory basins, water-closet pans, sinks, etc., are to be removed by rubbing with a small mop tied to a stick and moistened with diluted hydrochloric acid (spirits of salt); but warm salt water or soft soap will, as a rule, remove such stains.

Bad smells within the house may arise from other sources than defective drainage, although in very many instances the cause of annoyance lies in this direction; but, whatever may be the reason, the un-

pleasantness should be accepted as a warning to make immediate investigation to discover the cause and effect a remedy.

The smell peculiar to damp cellars or basements is quite distinct from that occasioned by rotting organic matter, and seems to suggest the presence of fungoid growth. Quite different, too, is the smell from the insanitary kitchen sink, which leaves an unpleasant, sweetish impression, or the pungent, searching scent of true sewer gas.

The decaying carcass of one small mouse beneath the floor will upset an entire household and amply avenge its untimely end from the poisoned bait, while the larger body of a rat in a similar condition may make the house untenantable.

The effect of sewer gas or drain air upon the body may be said to be cumulative, and, though its presence in the house may be imperceptible to the senses, a feeling of depression and loss of vitality soon become apparent, and one readily falls a victim to one or another of the many diseases which are always lying in ambush. Illustrative of this, the inhabitants of a somewhat large country house were subject to visitations of sickness every spring. The situation of the house was good, and it was, moreover, built upon a gravel subsoil overlying a chalk hill.

Drains were repeatedly tested and overhauled, although no unpleasantness was ever noticed, and every suggested improvement in this direction was made, but all to no purpose so far as limiting these outbreaks was concerned.

During open weather, when the house was well aired and an outdoor life was practicable for the family, the health of the household was particularly good; but a long spell of inclement weather, which necessitated closed doors and windows, made a remarkable difference, and the advent of spring invariably found the household in a flabby, depressed condition. Eventually it was discovered that an adjoining cottage was drained into a deep cesspool sunk into the chalk at no great distance from the cellars of the house and, although well ventilated, the gases from this receptacle filtered through fissures in the rock to the cellars, but in such small quantities as to be imperceptible to the ordinary senses.

The sickly smell from the kitchen sink, lavatory, or bath which is improperly fitted will have a marked effect upon the health of the household, although not so assertively unpleasant or so immediately dangerous as an escape of sewer gas, but it is extremely unwise to ignore the warning.

Sewer gas is characterised by a rank pungency not unlike the smell

from an old gas pipe, and, indeed, the two gases are so closely allied in chemical constitution that their identity is not easy to determine.

Sewer gas may be beaten down by wind eddies from drain ventilators badly placed with regard to prevailing winds or carried up to insufficient heights, or may enter the house from rain-water pipes, cistern overflows, or other ducts which are connected with the drains direct.

Foul smells may also arise from filthy rain-water tanks connected by pump or pipes to the house or rain-water cisterns situated near windows or on or in the roof of the house.

Section IV.—Dust, Dirt, Refuse

CHAPTER IX

DUST IN THE HOUSE

"If each before his own door swept,
The village would be clean."

DIRT has been most aptly defined as matter in the wrong place, and this definition cannot be more fittingly appropriate than when applied to such material in and about our homes.

Careless management, false impressions of economy, and idleness are responsible for the accumulation of dirt in many forms, and although it may not be perceptibly offensive its presence is none the less mischievous as a source of discomfort and a menace to health.

The miserable and dilapidated appearance exhibited by the backways of much of the smaller property of our towns is, to a very great extent, due to or increased by a miscellaneous litter of worn-out or broken utensils, scraps of floor coverings nailed to fences or wrought into sheds and shelters, and dust-bins full to overflowing with garbage of all descriptions.

The interior of such houses may be fairly judged by the disorder presented to our view, resembling in their primitive filth the aboriginal hut rather than the homes of civilised beings.

Hoards of useless lumber are accumulated in many houses of a more decent class which, from warped ideas of economy and false notions of prudence, are treasured up from year to year against some remote contingency of serving a useful purpose. Cast-off clothing probably figures to a larger extent as a result of this miserly habit than any other commodity, and the discomfort arising from stores of this kind can scarcely be overrated. Articles of apparel stacked away, in many instances in exactly the same condition as when discarded, are thrust into bedroom closets or piled in attics where they afford an asylum for insects and a lodgment for dust, besides vitiating the atmosphere of the house and seriously limiting the storage room for more useful

articles. True economy is to be realised by broader views than these, and a healthy home can never be maintained under such conditions.

The multitude of sermons which have been hung upon that ancient peg, "Cleanliness is next to Godliness," would have worked a reformation in the civilised world long ago were it not for the care with which the so-called rights of the individual are so jealously guarded. The introduction of reform, be it ever so essential, is at once assailed by a suspicion that the sanctity of the home is in danger or the abolition of personal liberty is threatened. The general apathy regarding the rights of others is perhaps particularly human, and the fact does not sufficiently weigh with us that others may be the worse for our neglect, or that the privileges of our neighbours may be violated by our wanton transgressions against the laws of reason. "The strength of a chain is as its weakest link": so the health of a community is directly dependent upon the mode of living of its most careless and indifferent members.

Character of Dust.

The oft-proven fact that dirt and dust mean disease should drive home the lesson to the most unobservant; but the acceptance of such teachings depends so largely upon the varying ideas of personal comfort, and these are again governed or regulated by the amount of work their practice entails, that a satisfactory solution seems hopeless without the aid of stringent sanitary laws.

A casual observer would probably characterise dust as earthy particles in a finely divided state, and would regard it as one of the inevitable evils which our imperfect nature renders necessary as an incentive to healthful action. But it may not have occurred to him that the atmosphere is naturally full of minute specks for the performance of allotted tasks in the great workshop of Nature, quite apart from the agency of man in its production.

Without dust we should have a much less beautiful and enjoyable world, and although its absence would rid us of the periodic discomforts of fog and mist we should be largely deprived of rain, and the general state of affairs would be far from pleasant, with an atmosphere alternating between parched dryness and excessive humidity, with moisture condensing profusely upon every object.

Dust in a clear atmosphere is composed of earthy particles, condensed gases, and the resultants of combustion, such dust being so finely divided that a puff of cigarette smoke has been estimated to contain many millions of particles.

The dust about our homes is, however, of much greater complexity,

and substances too frequently drawn from the most objectionable sources contribute to the sum of its iniquity.

The ceaseless attrition of material of all descriptions due to movement, both physical and mechanical, and the reeking of innumerable furnaces and domestic hearths, load the air with quantities of material which insinuates itself into every space, however tiny, into which air can gain access. However essential the presence of dust may be in the economy of Nature, the undue accumulation of a compound poisoned by the addition of atoms from such a wide range of questionable sources is to be emphatically avoided.

Natural or inorganic dust, composed of mineral matters, may be said to perform a useful service in the home by diluting and disinfecting the particles of organic substances which form so large a proportion of the dust produced by man.

To what extent this is beneficial we do not know, but we have it upon the authority of Dr. Angus Smith that "all fine powder disinfects," by reason of the air attracted and confined by the enormously increased surfaces of such bodies, causing more active oxidation.

Dust Traps. The construction of our houses leaves much to be desired in the matter of dust traps, but we must perforce take matters as we find them, to a certain extent, and, failing an ideal structure, attempt the suggestion of reasonable remedies, or at least palliatives, when actual remedies are beyond our reach.

The wood flooring of our rooms, although laid with a close joint when new, invariably shrinks in the dry and warmed house. The skirting-board retires from the floor, and numerous cracks and crevices become receptacles for dust and dirt, which is never removed. Variations of temperature cause draughts and currents of air, which carry the dust into cupboards and closets, behind and beneath heavy furniture, and into every conceivable nook into which the passage of air is possible. Lodgment for dust is afforded by the moulded cornice and frieze, the centre flower ornament of the ceiling, mouldings over doors and windows, pictures and bric-à-brac on the walls, and even the wall itself; all of which is liable to disturbance upon opening or closing doors or windows, or any smart movement which stirs the air in the room.

Comparatively little of this accumulation is removed, as a rule, by the usual dusting operations, especially that which lies upon ledges and projections above the eye level. The suggestion of a rigid abolition of all decorative effect of a nature calculated to afford lodgment for dust is not likely to find favour. It is therefore hopeless to expect the serious acceptance of strictures which condemn us to four bare

walls in apartments destitute of the many embellishments which usually render them attractive. But a revolution in design and form of decoration might assist in the lessening of the evil, and some such reformation is certainly needed in relation to the heavier pieces of furniture. However, the source of much of the trouble is to be found in the floor, and this can be governed in a very great measure by suitable treatment.

Floor. The amount of dust which may collect beneath a floor is really alarming when one considers the variety of contributory tenancies which have been responsible for its production. Who can say what diseases may have run their course within the chamber, or who can tell what potential germs may still be hidden in its dust? The usual covering of carpet, with perhaps a felting beneath, hides the unsightly floor and dispels the disturbing thoughts which its gaping joints would suggest; but this covering gives little protection against the steaming up of this ancient filth, if the floor is shaken by violent movement.

When expense has not to be considered the joints may be filled in with wood slips and the floor planed and covered with hard wood parquetry, which when polished gives an artistic tone to the whole room, or the flooring may be relaid with well-seasoned wainscot oak or other hard wood, with tongued or rebated joints, secret nailed, and polished, or laid with one of the jointless flooring compositions previously mentioned, either treatment effectually sealing up the space beneath and forming a dustproof surface; but in most cases these methods are entirely out of the question on account of the cost of such work.

The usual flooring is often of the poorest quality, and presents a surface too soft and altogether hopeless for direct wear. We are, therefore, driven to the necessity of covering it with some material for the sake of comfort and appearance.

Carpets. Carpeting collects and retains a quantity of dust from soiled footwear, and waste matters from many sources, and although frequently swept, much of the dirt finds its way through the fabric, or is retained within it until the covering is taken up in the yearly or half-yearly cleaning campaign. The constant traffic over the floor grinds up the dirt, and each footfall beats up its little cloud to be wafted hither or thither by every movement of air. Again, the process of sweeping, be it ever so carefully carried out, scatters some portion of dust from the floor about the room, necessitating much dusting and brushing of furniture and other objects,

during which process much of the dust is again dropped on to the floor.

Linoleum. The ideal floor surface should be smooth, non-absorbent, and reasonably wear-resisting, and, failing the ability to employ more perfect material, good linoleum appears to be the most suitable and advantageous for ordinary use. Exception has been taken to the use of linoleum by one or more well-known writers, on the score of exclusion of air from the floor-boards when covered with this material, and the consequent development of dry rot; but, even if practical experience can bring sufficient evidence to support this view, the fact remains that until some material equally inexpensive and serviceable is placed at our disposal, linoleum undoubtedly offers the least possible cause for objections on the part of the householder, and is therefore the means most likely to be adopted.

Preparation of Floor. A careful preparation of the floor is, of course, essential before this covering is laid, and after all inequalities and projections, such as nails, tacks, or protuberant knots have been removed or planed down and the floor cleaned, a sufficient time should be allowed for thorough drying before the material is laid down; it should be remembered that after the surface of the boards has dried moisture is still retained in the crevices of the floor and must be evaporated before the floor can be considered dry. In all probability the objection to linoleum previously mentioned may have arisen from the usual neglect of this precaution or from rising damp, badly seasoned timber, or insufficient ventilation beneath the floor. Then again, slovenly cleaning by slopping water over the linoleum leads to soakage through joints or badly worn patches, and the material becomes damp on the under side, and often quite sodden. The covering may be effectually cleaned by the vigorous application of a damp cloth, if the surface is kept in good condition, and this may be maintained by a weekly dressing with a good floor polish, after cleaning, which hardens the surface and lengthens the life of the material. No pains should be spared in fitting and fastening down the edges and joints, so that the possibility of dust traps may be minimised.

A good quality linoleum of suitable design need not be offensive to the most artistic tastes, and the use of small carpet squares and the disposal of a few rugs about the room will ensure a comfortable appearance; whilst the opportunity for the frequent removal of dust is greatly facilitated. The fact that dust is more apparent when lying upon the smooth surface of such a floor than in the case of a wholly carpeted space is a strong argument in favour of its use.

Paint Work. Painted surfaces often afford a lodgment for dust particles by reason of the inefficient treatment which they receive at the hands of the decorator. The work is too often cheaply done with badly prepared material and worse workmanship. In the first place, the surfaces are ill prepared to receive the coatings, and when covered with a paint, insufficient in quality and quantity, laid on by cheap labour, a rough and uneven surface is presented which collects and retains a quantity of dust. This adheres so closely that its removal is difficult and the drastic measures employed to effect that purpose destroy the paint. Unnecessarily vigorous methods are too often resorted to, it is true, but much of this is due to the tenacity with which dirt will cling to such badly finished work.

Nothing stronger than ordinary yellow soap and water, applied with a woollen cloth and rinsed off with clean cold water, should be necessary if the surfaces are well and skilfully treated in the first instance, and stronger soaps and soap extracts, which abound in scouring properties, should not be used.

Enamel. A hard, smooth surface offers little chance of collecting dirt if fairly treated, and the most serviceable finish is to be obtained by the use of one of the much advertised enamel paints for the last coat. The cost of such work is very little in excess of the ordinary painting, and is really more economical in the long run, as it lasts longer and requires much less labour to keep clean; but good workmanship in its application is necessary. The treatment of wall surfaces, other than covering them with a paper of doubtful quality and durability, is a subject which should perhaps be dealt with more fully in this section with a view to the selection of the material best calculated to improve the health and appearance of the home.

Walls which are subjected to steam, vapour, or gases, such as those of the kitchen, bathroom, scullery, water-closet, etc., may be oil-painted and varnished, or finished with enamel or coated with Blundell's petrifying liquid. This latter material is particularly suited to rough walls, and forms a glazed surface of pleasing appearance.

Washable Distemper. Artistic effects and good service are to be obtained from the use of washable distemper for the walls and ceilings of dwelling-rooms, bedrooms, passages, nurseries, staircases, etc., and, all things considered, this is probably the treatment most to be preferred, although many persons object to the somewhat bare appearance it imparts to the walls when compared with the decorative effect of the usual papered surfaces. This, however, may be relieved by the addition of a dado and frieze in different shades from the body colour,

and certainly pictures and other wall decorations are shown up with better effect upon such a background.

Some misunderstanding is associated with the use of such distempers and water-paints, arising from the poor results of their application to badly prepared or to newly repaired or plastered surfaces, resulting in fleeting colours and discoloured patches; but for this we are often indebted to careless or ignorant workmanship. The maker's instructions must be carefully followed in preparing the surfaces and in mixing and applying the colour, and in newly-plastered work the choice must be confined to those colours which are guaranteed to withstand the action of lime. The distemper is washable after the lapse of a week or two, and dirt may be easily removed by wiping down with a sponge dipped in clean tepid water.

"Sirapite" plaster, a favourite finish for interior plaster work at the present time, is somewhat erratic in its action upon some distempers, and it is wise to leave the surface untreated for at least two months and then thoroughly brush down and coat with the preparatory material recommended by the makers before applying the chosen distemper.

It is best to choose a well-known and reputable make, such as Hall's, "Duresco," Carson's "Muraline," etc., to ensure success. Dishonest tradesmen have been known to substitute ordinary distemper, which may account for some of the supposed failures of washable distemper; but the fraud may be easily discovered by rubbing lightly with a small piece of damp rag when the coating is two weeks old. Ordinary distemper will colour the rag, washable distemper will not be perceptibly removed. "Muraline" may be mixed with 10 per cent. of linseed oil to form a more permanent or a weather-proof coating, and Hall's Distemper or "Duresco" may be varnished.

CHAPTER X

THE DISPOSAL OF HOUSE REFUSE

"Egad, sir, sheer necessity."—SHERIDAN.

CIVILISATION has so increased our cares and responsibilities that man has no longer the right to order his life in accordance with the dictates of his own desires. His gregarious habits saddle him with responsibilities which the duty he owes to his fellow-beings forbids him to ignore. In no way is this truth more plainly exemplified than in the disposal of the household refuse.

Household Wastes. The ultimate disposal of the garbage of our kitchens, the refuse from the hearth and similar waste products, is catered for in cities and towns by the provision of receptacles into which the daily production may be thrown, awaiting removal by the local authorities by a more or less frequent collection. But such measures, however well arranged, do not entirely meet the needs of the case, neither do they absolve the householder from all responsibility in the matter, nor is it right that they should. Far too much is demanded in this respect, and the receptacles are loaded with a great deal that could well be otherwise disposed of, or greatly reduced in bulk.

Receptacles. The large open or wood-covered bins of wood or brick, the latter often sunk into the ground or built into or against the back wall of kitchen or scullery, are fortunately fast becoming obsolete, except in rural districts. The position of such receptacles is usually fixed for convenience as near to the house as possible, and in the height of summer the contents advertise themselves most unpleasantly, attracting and breeding flies in swarms, contaminating the atmosphere, and rendering their proximity insufferable. The whole structure of the bin, whether of wood or brick, becomes saturated with the stale, nauseating exudations from the refuse, and no amount of disinfecting powder or limewash can entirely banish the fetid odour. Conditions are improved but slightly where the use of the more modern type of portable metal bin obtains, for these are often filled to overflowing with a disgusting assortment of scraps and shreds. The cover, if one exists, is either bent out of all chance of serving efficiently its

intended purpose, or is more often thrown aside as a troublesome and altogether useless appendage.

Pails, tubs, barrels, baths, boxes, and baskets, for the most part in the last stages of dilapidation, and, in fact, anything that will form some sort of enclosure, however imperfect, are pressed into service. As a consequence, the ground around is always littered and stale with filth. What an inestimable boon to the household to be rid of this malodorous mess, with the consequent swarms of flies which infest the premises and make the warmer months a season to be dreaded! Yet a little thought and a little trouble would work this seeming miracle —far less trouble than is entailed by the endurance of such discomfort.

It is best to burn all refuse that it is possible to burn in small quantities, as it is produced. All vegetable refuse and parings, entrails, and offal of fish, flesh, or fowl—feathers, skins, and bones—everything, in fact, which cannot be utilised should be consigned to the flames.

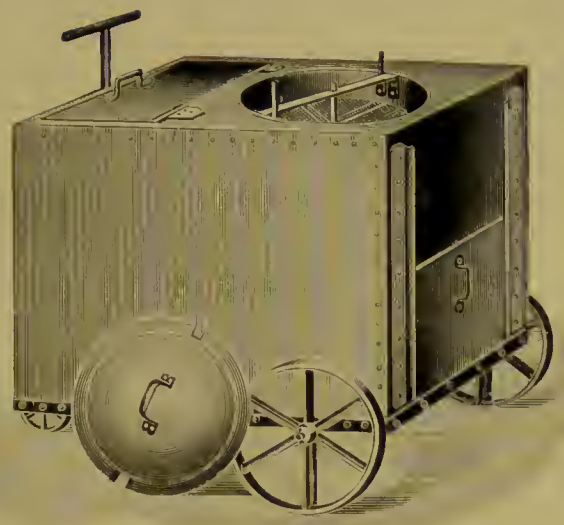
In these days when the use of the closed range is so common, there should be no difficulty in doing this, and quite considerable quantities of such refuse may be cremated after the cooking or baking is finished and while the fire is still fairly brisk, without the slightest offence.

No excuse or objection can alter the fact that this may be and in many cases is done in well-managed households. If properly and reasonably worked, all effluvia evolved in the operation will as readily ascend the flue as does the smoke of the ordinary fire, and the adoption of such a procedure will bring about a rapid decrease in the fly population, especially if all animal matters intended for the furnace are covered up or wrapped in paper until disposed of, thereby offering as little attraction as possible for these pests. As an alternative, where somewhat large quantities of offal or garbage have to be disposed of, the refuse may be decently buried in the garden, where it will be of some practical use as manure.

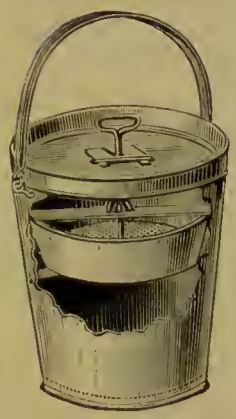
The Small Matters that Matter.

There are many ways of performing a duty, but generally there is one way which is to be preferred to all others. The difficulty which some people experience in discovering the right method is less surprising than the persistency with which others pursue a practice that they know to be wrong. The wrong way may necessitate more trouble and be palpably less advantageous in its results, but the difficulty of overcoming habit appears to be almost insurmountable.

The trouble possibly hinges on the lack of interest taken in the



DUST-BIN FOR COUNTRY HOUSE WITH MEANS FOR SIFTING CINDERS. WHEN FULL CAN BE WHEELED AWAY FOR DISPOSAL



HOUSEMAID'S PAIL AND CINDER-SIFTER

DUST-BIN WITH REMOVABLE BOTTOM TO ENSURE COMPLETE EMPTYING

DUST-BIN WITH FEET TO KEEP BOTTOM OFF GROUND

TYPES OF DUST-BINS

petty duties of life and the wilful inability to comprehend the simplest laws of cause and effect. "The trivial round, the common task," is an unutterable weariness to many, and the perfunctory performance of household duties is responsible for much of human unhappiness and misery. Mats are shaken at the open door or beaten against the very door frame, whilst the wind sweeps the flying dust into the house. Slops are thrown at random into the roadway or upon the yard or garden, when suitable provision for their reception and disposal lies close at hand. Dust swept up in the house is cast just outside or thrown into the open dust-bin to be blown back again by the first eddy of wind.

Much of the swept-up dust is burnable, and is consequently capable of being very much reduced in bulk; further, fire is the greatest and most certain of purifiers; therefore, burn all and every scrap of useless material and every speck of refuse which can be burned, and deposit in the dust-bin only such matters as have passed the ordeal of fire, or that fire cannot reduce, such as broken ware and discarded utensils.

Dust and Disease. It is well to bear in mind that the greater the accumulation of dust and refuse the greater the number of harmful microbes. In districts where the authorities provide for a daily, every-other-day, or even a weekly collection of refuse, the portable sanitary dust-bin is usually employed, and if the practice recommended above be adopted quite a small receptacle will be found sufficient to accommodate the wastes of a fairly large family, especially if all cinders are economically riddled out. The best form of sanitary bin is made of galvanised iron with a very loose-fitting lid made of the same material, a stout bail loop, and a handle to facilitate carrying and emptying by the dustman. The galvanised bin in common use is generally too large, and is constructed of thin metal, with a closely fitting lid. The bin is soon battered and distorted with frequent emptyings, and the lid is more quickly knocked out of shape and becomes practically useless for the purpose intended.

The bin should stand in a position where it does not catch the drippings from eaves or the overflow from a cistern, and it may be kept off the ground by standing it on two or three bricks laid flat. The bin should not stand immediately underneath a window or near a door into the house, and should be quite in the open. The lid should always be kept on.

Slops. Slops should not be thrown into the bin; liquids from the table, with tea-leaves, coffee-grounds, etc., may be safely emptied down the water-closet or yard gully. The practice of

emptying such matters into the dust-bin is productive of most of the unpleasantness arising from such receptacles, and in addition to this the liquids cement the fine ashes to the bottom and sides of the bin, rendering complete removal of the contents difficult or impossible, and the acids contained in the slops attack and destroy the metal. The rapid decay of the receptacle follows as a result of the combined action of rust and the energetic and reckless efforts of the dustman to knock out the caked accumulation. It is therefore advisable to avoid as much as possible the admission of moisture by abstaining from the above practice and by keeping the bin covered.

Discarded Clothing. Old clothing which has been entirely cast off may be used in and about the house as swabs or dusters, or may be turned to profitable account in transactions with the rag merchant; but it is not worth storage room, when the house would be sweeter and healthier by its absence. If for economical reasons it is desirable to keep some articles, these should certainly be washed or cleaned, so that they may be stored away without a chance of detriment to health or offence to the senses of the household; but all such material too worn or soiled for use, or of no value as merchandise, should be consigned to the flames and not deposited in the dust-bin.

Rags. Burn all rags or poultice cloths used in the sick-room at once; a second service is inadmissible, and danger is likely to arise from their exposure in the dust-bin.

Old bedding or mattresses one can often arrange to be removed and destroyed by the authorities, but if the garden is sufficiently large to allow of a decent bonfire it is much safer to burn it oneself. Objections, of course, will be raised to the amount of trouble which all this entails, and many of the suggestions offered may appear fussy and unnecessary, but the penalty for the neglect of reasonable precaution is as certain as the reward for cleanly living is sure.

Garden Refuse. The difficulty of dealing with garden refuse is at times a serious matter to the householder. It is difficult to stack it on the dust-bin, and the nicely discriminating mind of the dustman often creates difficulties which only *backsheesh* can overcome. The gardener man is a labour-saving machine, with a tendency to pursue his work along the lines of least resistance, and it is therefore no uncommon thing to see back roads, passages, and waste lands in the vicinity of the house utilised as dumping-grounds for all such refuse. The opportunity thus offered for easy disposal appears to be generally hailed as the most economical way out of the difficulty by most people, and every kind of waste material, including house refuse, is deemed

to be satisfactorily disposed of if it is over the fence. But out of sight is not necessarily out of mind, and the truth of this is realised, perhaps unconsciously, by the aftermath of flies bred in and attracted by the heating mass, and the objectionable odours which become prevalent.

Burnt or rotted down, the vegetation would be of some manurial value, and the residuum of the bonfire or the compost heap would return to the ground much of the earthy salts extracted therefrom by the growth. Sufficient exposure to sun and air will very soon render all such rubbish fit to burn, and a bonfire at night will seldom cause annoyance to neighbours, even in a town. If, however, such a course is impracticable, the whole may be closely heaped and covered with a layer of earth and rotted down without much trouble or annoyance.

CHAPTER XI

DOMESTIC ANIMALS, HOUSEHOLD PESTS

"Evil is wrought by want of thought,
As well as want of heart."

PERHAPS there is no hobby productive of the same amount of satisfaction to the individual as the keeping of domestic pets, or the farming on a small scale of animals and birds, but so often is this essayed in a space too circumscribed for healthy existence by those who have little or no knowledge of the needs and habits of the animals they keep, or the diseases to which they are subject, that the attempt results in a very large addition to the dirt and dust about the home, with the inevitable increase of dangerous micro-organisms.

The domestic animal, in common with civilised man, has developed a finer organism at the expense of a greater susceptibility to the influences of environment, and stands as much in need of careful housing, feeding, and keeping as does the human example.

The pig gains no advantage from his wallowings in the filth which is supposed to be natural to his state because he occasionally indulges in a mud bath in his wild condition. The deprivation of the civilised substitute for his native mud will rob him of very little pleasure, and will, moreover, improve his health. Similarly, birds of aquatic tastes will be infinitely healthier if supplied with ample drinking-water in easily cleaned and replenished receptacles, instead of the imitation pond with its germ-laden water and filthy surroundings; and the dog and cat who feed on carrion in their wild state, are not necessarily properly fed when supplied exclusively with such a diet under more civilised conditions.

Overcrowding is as injurious to one animal as it is to another, whether it be man or beast, and the domestic pet requires the same amount of consideration with regard to light, air, food and water, and exercise, as does man himself.

Transmission of Disease.

In the light of medical opinion, repeatedly expressed, of the great possibility of the transmission of certain diseases from animals to mankind, the necessity of a careful study of the animals we keep, with a view to proper housing, feeding, and general treatment, is as much for the safeguarding of

our own health as for the sake of the creatures dependent upon us. "Man's inhumanity to man" is only exceeded by man's inhumanity to the animals entrusted to his care, by his ignorant inattention and careless brutality in relation to the helpless beings to whom he stands as an all-powerful disposer of their destinies. To the bitterness of captivity are often added other ills in the way of insufficient space, meagre food, filthy accommodation, and general neglect. It cannot, therefore, be a matter of surprise that Nature should occasionally level up the balance with a retributive attack of disease thrown into the human scale.

Dog and Cat. Of all domestic animals the dog is the most popular among all classes, and although the cat, in point of numbers, is probably more noticeable, the attachment of the dog to the person rather than the domicile makes all the difference between the two animals and renders the latter an easy first in the favour of man.

Each of these animals is subject to intestinal troubles and other diseases which frequently escape the notice of the average owner, or are regarded as mere trifles. Rabies or hydrophobia is common to all animals, but it is said that it is particularly virulent in the dog and the cat, and it may be safely asserted that most outbreaks of this nature originate from the improper treatment or neglect of the creatures affected, and many cases of indisposition are falsely attributed to this disorder through ignorance of the symptoms of minor troubles.

Diphtheria, Dr. Klein asserts, is a natural disease with the cat. Fowls are subject to cholera, and all birds and many animals are susceptible to diseases of the respiratory organs. Tuberculosis and kindred diseases attack most animals.

The law provides that a pig shall not be kept within 100 feet of any dwelling-house, and the keeping of other creatures in such a way as to constitute a nuisance injurious to health is an offence against the law; but, short of such transgressions, offences against the health of the home are of frequent occurrence, chiefly because they appear to be such trifles. No animals or birds should be kept near enough to the house to be even occasionally offensive, and certainly far removed from any food-safe or cupboard, pantry, or larder.

Cleanliness. Absolute cleanliness is most decidedly essential, and all voidings should be buried or well mixed with garden mould and not merely thrown upon the ground, whence their dust may be blown into the house or about the premises. Sufficient bedding of absorbent material as the case may require should be provided to keep the animal and his dwelling in a clean and dry

condition, and this should be frequently renewed and the old material burnt or buried.

All disorders should be promptly treated with suitable remedies, or advice sought if the case be not understood.

Bedding. The bedding of dogs and cats should not be used, as it frequently is, until it becomes too filthy for longer service. Straw is really the best possible material for this purpose and can be frequently renewed, but when any woven material is used, periodical washing is necessary and more frequent airing and exposure to sunlight.

Pests. It is difficult to understand the passive acceptance of such uncleanly conditions as must exist where the home is overrun by some one or several varieties of the too familiar household pests. Exception may be taken to the term "uncleanly," but a house, however well kept in other respects, must necessarily be unclean where such a state of affairs is allowed to remain from year to year for the lack of some determined effort to eradicate the evil.

It has been pointed out that, in addition to the annoyance occasioned by the presence of these pests, there are grave risks of introduction, through their agency, of disease germs by fouling articles of food, by the bites of the pest, or the parasites it carries. Dr. Sambon, of the London School of Tropical Medicine, says, with reference to the Manchurian plague, "without fleas, plague rats and plague patients would be harmless," and he further states his firm belief in the spread of such diseases as typhus fever, small-pox, measles, scarlet fever, and mumps by blood-sucking insects and other body or household vermin.*

The appearance of rats or mice is generally sufficient to inspire a species of terror which leads to the poisoning or trapping of the intruders as quickly as may be, but the invasion of insects is often looked upon as quite a minor matter, especially if they be of nocturnal habit.

A lady was recently told by a horrified neighbour of the sudden appearance of blackbeetles in her kitchen. "Oh!" was the reply; "we have lots of those, but we have grown quite used to them."

Flies. Flies are the most pernicious and difficult invaders to combat. The disgusting use of fly-papers and sticky mixtures placed about the house to effect their capture is often a source of danger where young children are present, and is, moreover, an attraction, which has the effect of increasing the swarm of the deceased's relations. The same may be said of the baited fly-bottle and fly-cage.

* *The Times*, February 3, 1911.

The best course to pursue is to leave nothing about upon which they can feed. Keep the house sweet and clean and well ventilated. Flies will not congregate in rooms through which a sharp current of cool air is passing, but are attracted by close rooms and unclean smells.

Keep the yard, garden, and all approaches to the house clean of garbage and accumulations of rubbish; keep the dust-bin covered, and do not allow dog-kennels, rabbit-hutches, fowl-houses, or other accommodation for domestic creatures to be situated close to the house.

If one-tenth of the people understood the physical peculiarities and habits of the house fly, more determined and effectual attempts would be made to put a limit to its unrestrained invasion of the house.

The fly is bred in stable manure or similarly moist filth, to and from which it is subsequently and frequently journeying. When feeding, the proboscis or trunk is extended and liquid food is so greedily sucked up that the crop into which it is received is frequently overgorged, and a portion of its contents is returned into the liquid upon which it is feeding. Dry or half-dry food is devoured by repeated moistening with liquid from the crop. The germs of many diseases have been found in the crop of the fly and the eggs of intestinal parasites.

Bedroom Pests. The ordinary bedroom pests are only to be routed by a vigorous campaign and individual slaughter, in conjunction with the maintenance of a state of extreme cleanliness.

In re-papering, every scrap of old material should be removed from the walls, including the interior of cupboards, every hole or crack in the plaster thoroughly stopped, and the walls washed with a weak solution of carbolic acid before repapering, or, better still, the walls prepared and coated with Hall's distemper.

Open joints in bedsteads, mattress-frames, or other furniture which afford hiding-places for the insects may be treated with an injection of paraffin oil applied in small quantities by means of a small oil feeder, syringe, or fountain-pen filler.

When scrubbing the floors use half a gill of "Izal" or Jeyes' fluid to each bucket of water. This will serve to discourage them from hiding in the crevices of the flooring or behind the skirtings.

Beetles. Blackbeetles and cockroaches, when established in a kitchen, are most difficult to get rid of. Beetle-traps only serve to diminish their numbers, but will not eradicate them, and poisons appear to be more dangerous to family pets than to the enemy for which they are designed.

The ordinary insect powder is said merely to intoxicate, instead of

killing them. Several mixtures are given in McEwan's "Pharmaceutical Formulæ" for their destruction, such as:—

Red lead	1 part
Fine oatmeal	4 parts
Red lead	2 parts
Borax	6 parts
Sugar	3 parts
Cocoa powder	1 part

But a footnote remarks, "It must be confessed that the insects frequently thrive on these powders."

A more reliable dose appears to be:—

Plaster of Paris	1 part
Wheat flour or rice flour	2 parts

But the only really satisfactory method of tackling the difficulty is to repair the structural defects which allow the pests to find hiding and breeding places. These are to be found in open joints at the sides or beneath ovens, coppers, stoves, etc., beneath hearth-stones and the floor immediately adjoining cooking or heating appliances.

Communication from house to house is likely where stoves or coppers are built back to back against the party wall, the insects making their way through the imperfect joints of the rough brickwork at the back of the furnaces. Relief may be found by carefully stopping up all visible cracks and joints in brickwork, stonework, or hearth, which may form points of egress, with suitable cement well pressed into the openings; but where the evil is of long standing a satisfactory cure is only to be worked by pulling out the stoves, etc., from their settings, clearing away every scrap of the old brick rubbish, thoroughly pointing or stopping the joints of the brickwork at the back, relaying the hearth with concrete, and solidly re-setting the appliances, taking care to point up all work thoroughly. The floor, if defective, should be relaid with rebated boards nailed upon concrete.

Rats. Whatever the struggle may cost in painstaking, contriving, and persistency, the rat should be kept as far away from the home as possible, as, apart from its unsavoury reputation as a germ-carrier, its appetite is voracious and its power for mischief great.

No other pest in these latitudes is capable of rendering a house so absolutely uninhabitable as can the rat by its subterranean burrowings and predatory operations. Drains are undermined and broken into, and direct passages constructed from them to the house; tunnels

are driven from the house into manure pits, ash-pits, and other malodorous receptacles; lead soil-pipes are pierced, and *caches* of half-devoured food and offal deposited under the floors.

The rat is crafty and not easily trapped unless spring traps are set in its runs and disguised; therefore, poison is often employed to accomplish its destruction. But within the precincts of the home the latter course is by no means advisable, as the victims crawl into their holes to die and become probably more objectionable when dead than alive.

Upon the earliest appearance of the invaders operations should commence by removing anything which may form an attraction for them or afford an asylum; stopping up their holes and defiling their burrows by pouring in tar and paraffin, both of which they detest.

If the house is much infested the drainage system must be thoroughly overhauled and repaired, the floors pulled up, and a layer of good concrete spread over the site to prevent further incursions; outhouses and sheds should be paved, and wood piles, stores, fowl-houses, etc., examined, and, if necessary, removed if it is found that they afford harbourage to the enemy.

Mice. Mice, although less dangerous, are still most undesirable as guests, and should be warred against as vigorously as the larger game. Poisoning should not be resorted to, as, with the assistance of a few spring traps and perhaps an active cat, the struggle should not last long if hotly pursued; but the points of entry into the house should, if possible, be discovered, and the holes stopped, and, if necessary, the ground surface beneath the floors concreted.

Ants. Occasionally the home may be troubled by a plague of ants, which swarm into cupboards and larder in hundreds, to the consternation of the housewife, who finds that no dainty which they fancy is to be kept from them. Traps appear to be useless, and the increase in numbers becomes alarming.

A careful search around the walls of the house will generally disclose the headquarters of the colony, from which sorties are made through tiny holes in the joints of the walls into the house. The ground should be opened so as to expose the settlement, and the place well watered with a solution of 3 oz. of crude carbolic acid or "Izal" to 1 gallon of water. It is necessary to treat a sufficiently large space on either side of the colony in order to ensure success.

If the ants have established themselves within the house, similar measures must be adopted and floors or walls made good in the best possible manner against a second attack.

Section V.—Light and Air

CHAPTER XII

WINDOWS AND VENTILATION METHODS

"A dark house is an unhealthy house, an ill-aired house, and a dirty house."—Sir Douglas Galton, F.R.S.

The association of darkness with evil things is founded upon a bed-rock of truth as old as the world. Man instinctively turns to the light for protection from a host of undefined horrors and unspeakable ills which lurk in the shadows. This natural antipathy to darkness would seem to indicate an intuitive knowledge that light is necessary for our well-being, and we should realise that no pains should be spared to obtain an abundance of natural light in the home. Every room and every passage, staircase, and lobby should be as well, and indeed as brilliantly, lighted as the situation of the house and general circumstances permit.

Windows. There should be an effective lighting area or surface of glass to each room equal to at least one-tenth of the floor space, and more if possible, and every window should be fixed in an external wall. Borrowed light—that is, obtained from windows or glass panels pierced through internal walls or doors — is not an equivalent, and is only permissible for lighting passages and staircases where better means fail. Skylights are also unsuitable except for the latter purpose or for cistern-rooms or box-rooms in the roof, and even these must be made to open easily for ventilating purposes.

Each window should be so constructed that at least one half of it may be opened to the full extent. In sash-hung windows this should be the upper half, but it is preferable that both halves of the sash should be so arranged.

Position of Windows. The top of the window—that is, the glass itself—should not be more than 9 or 10 inches below the ceiling, so that the light rays may illuminate as large an area of walls and ceiling as possible, and also form when opened an effective outlet for heated gases and vitiated air which rise to the top of the room.

The position of the windows should be such that laterally the entering rays have an equal illuminating effect to each side. The most effective angle at which light rays can enter is one of forty-five degrees, which may be best represented by a line drawn from corner to corner of a square. The whole of the glass area, unless very liberal provision is made, is needed for the admission of light and the blind should not be allowed to obscure the whole or the greater part of the upper sash, nor should heavy curtains be so hung as to decrease further the lighting of the room.

The prevailing art of window furnishing consists in the use of voluminous draperies, which rob the room of one-half at least of the much-needed light, and a further reduction is often made by the use of half-blinds, or by the exhibition of a collection of sickly plants whose woeful appearance might justly stand as an indication of the health of the dwellers within such apartments. Obscured or figured glass should not be used unless there is a super-abundance of light, nor should any window decoration or embellishment be employed which perceptibly darkens the room.

The value of the reflecting agency of the ceiling is sometimes overlooked, and we may find badly-lighted back kitchens and dingy offices made still more sombre by the substitution, for economic reasons, of stained and varnished matchboard in place of the usual whitened plaster. Gaily painted ceilings are out of place in small drawing-rooms, where the one window, even if stripped of its heavy hangings, would be barely sufficient for the adequate lighting of the apartment.

Light *versus* Disease.

Light is the natural foe of most disease germs, and no opportunity for the survival of any such unwelcome guests should by any chance be permitted to exist. Fungoid growth is more prolific in dark or dimly-lighted places, and so intimate is the relationship between this form of life and disease that the appearance of mould or similar growths is to be treated seriously and with suspicion. A quite recent instance, quoted by Dr. Jas. Braithwaite, relating how a child's throat, apparently infected with diphtheria, was discovered to be patched with mould of identically the same form as that growing upon the wall immediately over its bed, is sufficient to prove the importance of this fact.

External obstructions to the entry of light should not be permitted to exist where it is possible to remove them. Overgrowing shrubs, trees, or creepers must be pruned or removed, high walls or fences reduced in height, and sheds or earth-banks removed or cut back to clear a sufficient space for the purpose. Where such a course of pro-

cedure is impossible, light may be reflected into the apartment by the use of prismatic glass or other reflecting agencies suitably fixed.

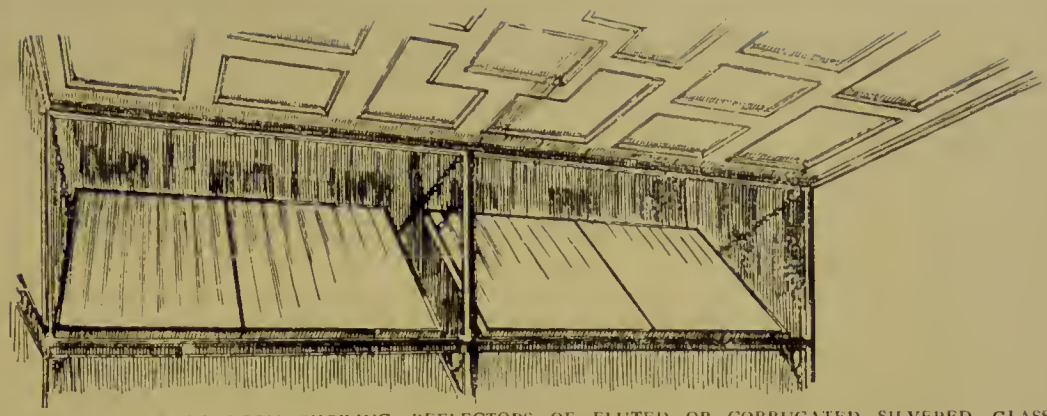
Daylight reflectors, made of ribbed, fluted, or corrugated glass, which can be fixed at any angle and suspended or attached in a variety of positions, are excellent for this purpose.

Few people appear to realise the health-giving properties of direct sunlight, otherwise the determined way in which it is shut out is difficult to understand. A leak in the roof on a rainy day is hardly more calamitous than a gleam of sunshine across the floor of the drawing-room, and any suggestion for the admission of unlimited sunshine would be flouted as the height of folly. Sunshine as a cure is to be understood, but as a preventive—that is quite too new an idea.

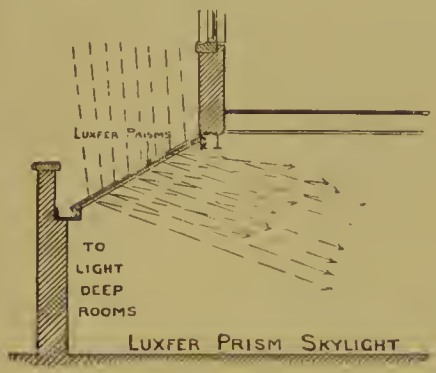
Sunlight as a germicide and general disinfecting agent is one of Nature's provisions, and when we, as a people, are wise enough to recognise truly the need of such agencies as sunlight and fresh air in our homes we shall be within measurable distance of that much-desired discovery—the cure for consumption.

Air. The operation of breathing is necessary for the oxidation or purification of the blood, which has become thick and unwholesome with impurities collected in the course of its journey through the body. During the filtering or cleansing process carried out by the lungs the poisonous product or waste is exhaled in the form of a heavy gas known as carbon dioxide. This gas is present in the ordinary outdoor atmosphere to the extent of from 2 to 5 parts in 10,000, parts of air, and the maximum proportions allowable in a healthy atmosphere is from 6 to 8 parts in 10,000, so that the exhalation of nearly 1 cubic foot per hour of this poisonous product by an adult, in addition to emanations from the body of other deleterious matters, indicates that the volume of air required to support a comfortable and healthy existence is a very considerable one. In fact, a man requires the use of no less than 3,000 cubic feet per hour, or a bulk of air represented by the cubic contents of a room 30 feet long, 10 feet wide, and 10 feet high. The inference is therefore plain that an ordinary room cannot afford healthy accommodation for even one adult, unless the volume of air is frequently changed or replaced. This is what is meant by ventilation.

Ventilation. Although we cannot hope by any means of ventilation to maintain the internal atmosphere of our homes at that degree of purity which characterises the outside air, we certainly can, and should, establish a much higher standard than that with which we are ordinarily content.

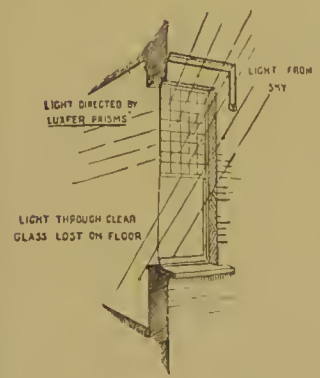


INTERIOR VIEW OF ROOM SHOWING REFLECTORS OF FLUTED OR CORRUGATED SILVERED GLASS FITTED TO UPPER PART OF WINDOW



SHOWING HOW LUXFER GLASS DIFFUSES LIGHT

APPLICATION OF LUXFER SCREEN TO WINDOW



SHOWING ANGLE OF LIGHT RAYS PASSED THROUGH LUXFER GLASS AS COMPARED WITH ORDINARY GLASS

It is said that pulmonary consumption is six times more fatal among indoor workers than among those following open-air occupations.

Some years ago Dr. Maculloch stated that the inhabitants of the Hebrides, while occupying their primitive huts, which allowed of a free passage of air through them, were entirely free from fever; but when the would-be philanthropic landowners erected new and commodious dwellings, intended to afford greater comfort, the stagnated air, combined with the uncleanly habits of the dwellers, produced frequent outbreaks of infectious disease.

We could instance dozens of houses, each of which has its own peculiarly unpleasant odour that assails us as soon as we enter. Each room, moreover, has its own distinctive unwholesomeness, from the stuffy bedrooms to the sinky kitchen or the dining-room "redolent of dead and bygone dinners," all speaking plainly of the absence of sufficient ventilation.

Folks ensconce themselves in a room heated to a tropical degree with perhaps two or three gas jets in operation, each of which is poisoning the air to the same extent as would four or five adults. Every crevice by which air can gain access is, where possible, carefully stuffed up; and, hugging themselves in an ecstasy of drowsy comfort at their freedom from draughts, the occupants settle down to enjoyment, until even the cosiness palls and the agreeable lassitude becomes a dismal oppression. Soon the accumulating foulness of the air produces headache and nausea, and they are glad to take a turn in a cooler atmosphere, or wander off to bed perchance to sleep, for the bedroom, though cooler, offers little relief to the weary lungs. The chimney register is closed to avoid down draughts; the windows are carefully shut to exclude the night air, and have probably been closed for the whole of the day for reasons equally fallacious, and the room is pervaded by a sourness which habit has rendered unnoticeable. Rest is impossible, sleep is fitful and unrefreshing, and one wakens at morn still tired, and has recourse to a favourite drug or patent medicine to stimulate the jaded system.

It is undesirable to labour the matter in the attempt further to show the absolute necessity of an ample supply of fresh air—a fact with which nine people out of ten are perfectly acquainted—but the point which does require driving home is that the majority of persons are practising habits and living under conditions which do not allow of this supply. Year in, year out, the same routine is observed with all its attendant discomforts, and the resultant feebleness of health, and still the recognition of the truth is subordinate to the fallacies

of long past generations, or the shadows of innumerable whims and fancies.

That efficient ventilation is a difficult matter to accomplish is a well-known truth, and it is not the purpose of this work to attempt a scientific and technical dissertation upon the many systems which claim to be infallible; but to suggest some simple means and expedients which may ameliorate the conditions, if they do not constitute an effectual remedy for badly-aired houses.

Ventilation in the home is more often a matter of practice than of construction, and although defects of the latter nature may not perhaps be corrected, the cultivation of common-sense habits will go far towards the elucidation of the difficulty.

Draughts. The horror of draughts is the one thing above all others which defeats many attempts at ventilation, and to the minds of many draught and ventilation are synonymous. Ventilation is a natural force created by the changes of atmospheric temperature and pressure, which seeks to remove the vitiated air from the neighbourhood of our bodies. Man counteracts this attempt by building practically air-tight dwellings, in which such exhalations and emanations are trapped and retained, instead of being naturally carried off. Every effort is made to keep out the air, which is eager to enter, by such devices as draught tubing and listing fixed round doors and windows, without consideration of the fact that the dreaded draught will rush in with increased fury through all those interstices which it is next to impossible to guard, and, instead of having the beneficial effect of a properly admitted current of air, extreme discomfort is experienced, both from draughts and the staleness of the atmosphere.

It has been estimated that the quantity of air escaping by way of the ordinary open chimney beneath which a fire is burning is about 29,000 cubic feet per hour. If the customary conditions prevail by which no provision is made for the ready replacement of this volume of air in the apartment the necessary supply will be drawn through floors and every possible crevice at a high rate of speed, to the creation of innumerable cold currents of more or less keenness from all directions. If we apply draught-preventing material to the windows the air will rush in the more furiously through keyholes and beneath and around the door; stop these inlets, and fiercer entry is made at other points. Ventilation without draughts is certainly impossible, but the incoming air may be so admitted and directed that a minimum amount of discomfort is experienced.

When the air is forced to enter by chance channels of small dimen-

sions, it follows that the currents will be swift, and will consequently travel far into the room before their force is spent; but if air is admitted in larger volumes, its passage will be much slower and will allow of easier diffusion. The objection to the admission of large volumes of cold air into a heated room in winter is reasonable, and means can be adopted to warm the air upon entry, but to seek comfort in attempting to exclude it altogether is absurd. Moreover, it cannot be too emphatically stated that much less harm is to be feared from currents of cool air than from an atmosphere of heated and soiled air.

Difficulty of Ventilating.

Theoretically simple as the task may appear, a system of ventilation which shall be satisfactory to all sorts and conditions of mankind has yet to be discovered. "It seems such a simple thing, this change of air—only to keep open the window a little, to have a fireplace and a convenient door. And yet some of the brightest intellects of the century have been engaged in devising means to accomplish the result, and all are not yet agreed as to which is the best way." *

The futility of mechanical devices which are dependent upon the will of the sensitive individual who feels the slightest current of cool air and the total unreliability of any automatic fittings to ensure a satisfactory result make the problem of efficient ventilation most complex. The very presence of anything in the form of a ventilator is sufficient to awaken apprehensions of evil effects in the minds of many persons who are not content until the dreadful thing has been shut off, stuffed up, or papered over. There would appear to be little chance of devising any workable scheme of ventilation until education has trained the general mind to the appreciation of the advantages to be derived from the acceptance of more reasonable views.

The physical discomfort occasioned by draughts cannot be an excuse for the persistent practice of keeping rooms closely shut when unoccupied, and during perfectly open weather. Frequent airing by opening doors and windows, when weather conditions are favourable, will make all the difference to comfort when the rooms are again needed for occupation, and a fresh atmosphere will replace the former heaviness and staleness.

It may not be generally remembered that some disease germs retain their virility for a long time, and actually thrive in a stagnant atmosphere deprived of its due amount of light. This may account in

* Professor Doolittle, "Inventions of the Century."

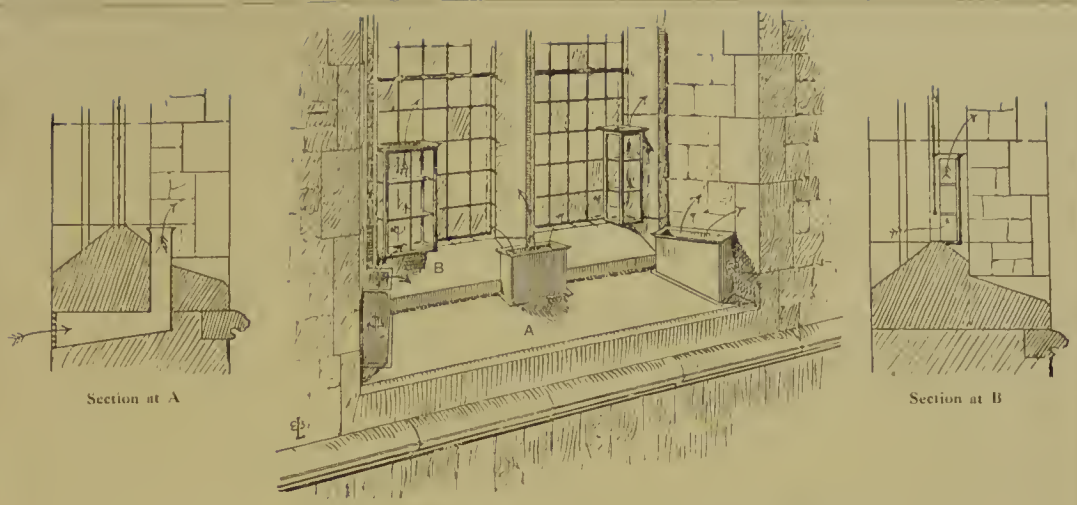
some measure for the prevalence of diphtheria. Typhus fever very rarely spreads in well-ventilated houses, because its germs are speedily destroyed by fresh air. Diarrhœa is encouraged by deficient light and ventilation, inasmuch as food, milk, water, etc., are contaminated by the tainted atmosphere.

Source of Supply. In considering the admission of fresh air into the dwelling, it must be remembered that it is impossible to obtain a supply of any great degree of purity if the external conditions are insanitary. Air which has travelled over filth-bestrewn gardens or unclean yards, or from the neighbourhood of defective drains, dirty gullies, or festering dust-bins, is already polluted before it enters, and the mere fact that it is external air does not ensure its healthy character.

Air Space. A certain extent of air space at the rear of every dwelling is demanded by the building by-laws of most neighbourhoods. This is no arbitrary enactment, nor utterly devoid of reason, as so many people seem to imagine, and in a crowded neighbourhood the necessity for preserving such a space unencumbered by buildings of any kind is imperative, if the necessary supply of fresh air to the dwelling is to be maintained. An efficient open space in front of the house is also ensured by the regulated width of the street and the prescribed building line, both of which are to some extent dependent upon the size and class of the property fronting thereon and the importance of the thoroughfare.

If the space at the rear is covered with sheds, fowl-houses, greenhouses, etc., the free circulation of air to the lower story is necessarily restricted and, moreover, often polluted by the dirty condition in which such places are kept.

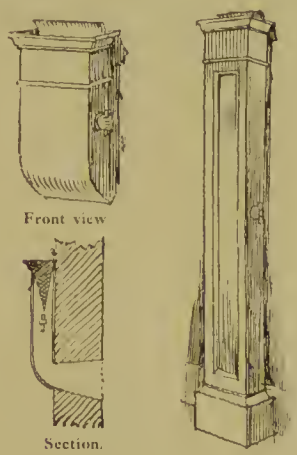
Encroachments on Air Space. The position most favoured for the erection of a greenhouse, with small property, is the yard immediately in the rear of the sitting-room or kitchen. This is usually an "improvement" added by the tenant, and the extent of the building generally covers the space overlooked by the one window of the sitting-room and the back door, and sometimes encloses the whole of the yard on to which the scullery, pantry, and water-closet open. Such an arrangement may appear an ideal one from the amateur builder's point of view, as it provides a cheery ante-room in the summer-time and affords a most useful covered way in bad weather; but, in addition to the interception of a great deal of light to the windows enclosed and the serious limitation of air-supply to the house, the building probably encloses the soil-pipe from a water-closet on the first



Section at A

Section at B

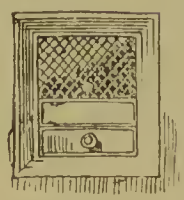
AIR INLETS OF VARIOUS FORMS FITTED TO WINDOWS



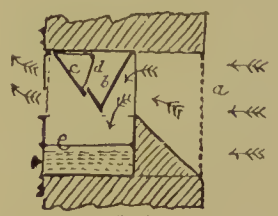
Front view

Section.

TOBIN TUBE VENTILATORS

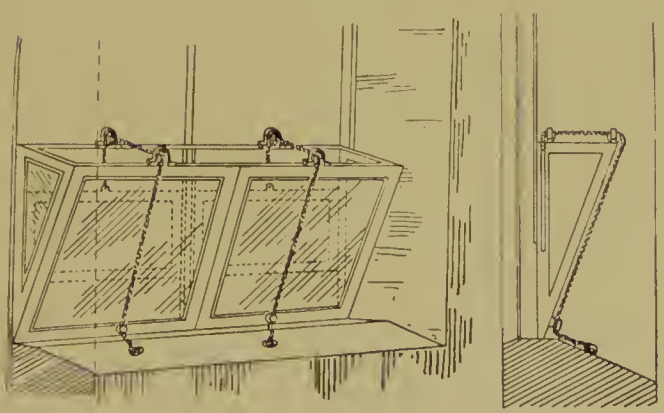


Front view

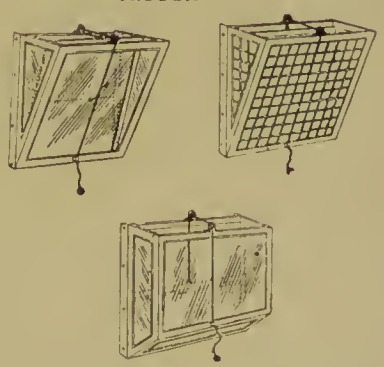


Section

PANEL INLET WITH WATER TROUGH



HOPPER INLET TO WINDOW



These inlets can be fitted with filters, or troughs for washing, cooling, warming, or medicating the air

INLET VENTILATORS

floor, the hopper head and waste-pipe from the bath, and the sink waste gully.

Now, particular care has been taken, in the designing and construction of the dwelling, that all such pipes and gullies should be fixed *outside* the building, as required by sanitary laws. The same laws require each room to have a window opening *directly* into the external air. Here the tenant has gone to a great amount of trouble to frustrate these provisions, and in effect has moved the gully and waste-pipes into the house, with the result that the gases evolved from decaying matter which is deposited in the gully, on the sides of hopper head and waste-pipes, and possibly gas from an imperfectly jointed soil-pipe, are not carried off as they should be, but are mixed with the air confined in the greenhouse, which forms a reservoir for the house supply.

Overshadowing trees, lofty buildings, or raised ground near the house have a distinct effect upon its ventilation, by intercepting and deflecting winds and cutting off light and sunshine.

Influence of Sunlight. Although sunlight has no direct warming influence upon the atmosphere, yet walls, fences, furniture, and fittings exposed to the rays absorb heat and give it out to the air, thereby creating streams and currents, which play an important part in the great scheme of natural ventilation.

Position and aspect may therefore have a decided influence upon the possibilities of successful ventilation. It has already been pointed out that comfortable ventilation depends upon the quantity of air admitted; but to ensure comfort this quantity must be large enough. Everybody knows that the draught from a partially opened door is keener than when the door is thrown wide open. The reason is this—a certain volume or quantity is being drawn into the room within a definite period, say 500 cubic feet per minute. If the door is set ajar 6 inches, about 4 feet superficial is allowed for entry and the air must travel at the rate of about 120 feet per minute to supply the demand. If, however, the door is thrown wide open and the area is greatly increased, the air in consequence travels at a greatly reduced speed.

To say we will not admit so much is impracticable. If the area is restricted the air must travel rapidly to satisfy the demand, but if the opening is large the current is slower, because a greater bulk is passed in the same time.

Speed of Currents. Air travelling at the rate of 1 foot per second creates no perceptible draught; 2 to 5 feet per second is just perceptible. A velocity or rate of speed higher than 2 to 3 feet per second is therefore inadmissible, if draughts are to be

eliminated. The supply inlets must, then, be sufficiently large to allow the air to enter at a slow pace, and of such a shape that the diffusion of the stream is assisted as soon as it gains an entrance, thereby decreasing its speed still further.

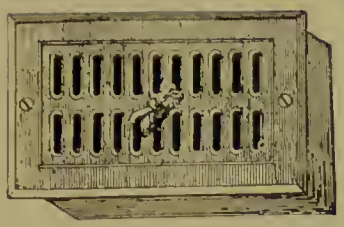
Inlets. The position of the inlet should be such that the air is drawn from the purest possible source and delivered into the room in the most advantageous position for general diffusion and the avoidance of discomfort.

Each room should have its own inlet, or inlets, led direct from the external air by the shortest route practicable. The best working arrangement for ordinary dwelling-rooms is, briefly, air inlets of sufficient size placed about 6 feet from the floor and an outlet at or near the level of the floor, the outlet being represented by the open flue of the fireplace. Outlets placed about 9 inches from the ceiling may be provided for the escape of heated air and gas fumes when the fire is not in operation, but these must be fitted with silk, mica, or aluminium valves, so that an outflow only is possible.

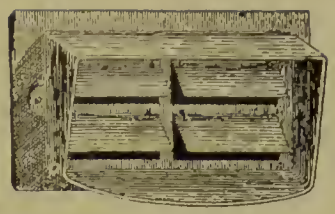
The air inlet may be of very simple construction, and is best situated when over or near the fireplace, or at the window, but the supply *must* be drawn direct from the outer air.

Tobin Tube. An approved form of inlet is the Tobin tube, constructed of thin metal and fitted to a hole made through an external wall. The tube is turned upward on the inside of the room to assist diffusion and to prevent direct draught, and is fitted with a shutter for the regulation of the supply, and perforated screens or baffle plates to break up the stream. The hole in the wall is guarded on the outside by an iron grating to prevent the intrusion of birds or small animals.

Simple Inlet. Another form of inlet, which is possibly more simple, is made by cutting a hole through the wall in such a way that it widens out at the top and sides as it enters the room. For a room of moderate size this may be externally 18 inches by 12 inches, and on the inside of the room 24 inches by 15 inches. The outside is, of course, guarded by a grating, and a screen of perforated zinc is provided for breaking up the current. The inside opening is covered with a frame fitted with thin metal strips or louvres, so hung that they may be opened or closed like the laths of a Venetian blind. The whole passage should be lined with smooth sheet zinc to avoid friction. Both screen and louvres should be fixed so that easy removal for cleaning out dust, etc., is possible.



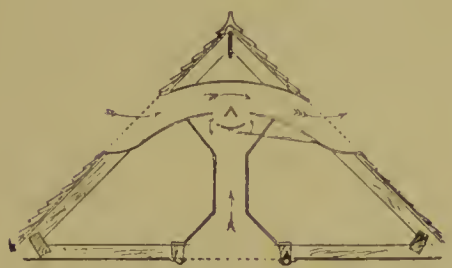
Front view



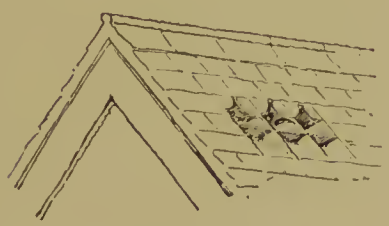
View of back, showing flaps

MICA FLAP VENTILATORS

As fitted in open roof

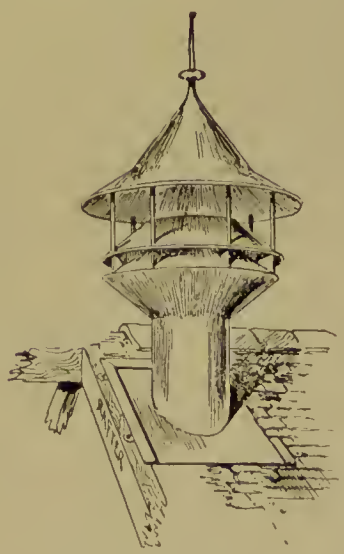


As fitted in ceiled roof



External appearance

BOYLE'S "AIR-PUMP" VENTILATORS



AIR-PUMP VENTILATORS

OUTLET VENTILATORS

Hinckes-Bird Method. A well-known form of inlet, which should commend itself on account of its extreme simplicity and cheapness, is the Hinckes-Bird device. This consists of the provision of a piece of wood 3 inches wide and about 1¼ inches thick, and the length of the bottom rail or frame of the window-sash. The lower sash is raised, the block dropped in position, and the sash shut down upon it. A space for the passage of air is thus formed between the two sashes, at the meeting rails. The position of the two frames gives the necessary up-throw to the current, and prevents direct draught and the wholesale entry of dust and dirt. Such an arrangement is of great utility where no other inlets are provided, but for thorough ventilation of large rooms this should be regarded as supplementary only to more permanent means of air admission.

The Cowper-Coles draught-proof ventilator is an artistic panel formed of two glazed frames with a space between fixed in the upper part of the window. The outer surface is glazed with ordinary clear glass and the lower portion hinged to fall inward to admit the air. The inner surface is in two panels, the lower and smaller one, immediately opposite the inlet, being of ordinary glass, and the upper portion lead-framed in very small squares and glazed alternately with tinted glass, the intermediate squares being unglazed. When the inlet is open the air passes up between the frames and issues into the room through the unglazed squares, and as the collective area of these is much greater than that of the area of the inlet panel, the diffusion of the air upon entry is facilitated. The Sheringham ventilator is a well-known type of inlet, which can be obtained in various forms through any ironmonger or builder, with or without baffle plates and dust screens.

Outlet. An important point to be considered in the provision of inlets is their capacity in relation to the outlet. The size of the chimney flue is ordinarily 14 inches by 9 inches, or 126 square inches, but owing to interior plastering, or pargetting, contraction at chimney-pot, allowance for friction and other reasons, the effective area for passage of air is only about 80 square inches.

The current of ascending air when a brisk fire is burning is considerably faster than the desirable pace at which fresh air should be admitted, and unless we can heat the air as it enters it is advisable to have the inlets of a capacity at least double this area, say 180 square inches, which will at times be supplemented by air currents entering at doors and windows. A fairly comfortable state of air exchange may thus be established, but it is a difficult matter to ensure

immunity from draughts in winter-time unless some method of warming the fresh air, or a portion of it, is adopted.

Much may be done by the use of screens and *portière* curtains in deflecting and diffusing the incoming air at windows and doors, but it is worth repeating that attempts to exclude all draughts are futile, and that free entry of sufficient air at suitable points is essential to health and necessary to comfort.

Down Draught. Down draught in flues results chiefly from insufficient ventilation. In the ordinary house, where ventilation is purely a matter of chance, air is drawn by way of passages and staircase from one room to another, and the lighting of a fire in a lower room will often cause the air to be drawn down the shorter flues upon the upper floors, to replace that which the fire is sending up the chimney. Other causes are frequently conducive to smoky flues, but the major part of such cases would be cured by sufficient fresh air being admitted to each room. In the absence of such inlets, the cooling of an overheated room by opening the door simply means that the vitiated air is carried into the adjoining apartments and the "fresh" air is drawn from basements through kitchen, scullery, and water-closet, or from bedrooms and possibly sick-rooms.

Unless a room is uncomfortably warm, the need for ventilation is not recognised by a great many people, and then the apparently obvious remedy is to open doors and windows to the general discomfort, and at the no small risk of dangerous chills, until the atmosphere is somewhat less oppressive. A constant and efficient supply of fresh air will prevent such overheating and the need for such drastic remedies.

Airing Rooms. The airing of rooms when unoccupied has been already mentioned. A daily practice should be made of admitting as much external air as possible into every room in the house and setting up a wholesome through current by opening doors and windows as wide as weather conditions will permit, summer or winter, for as long as possible during the brightest and freshest part of the day.

If, in consequence of boisterous winds, extreme cold, or wet, the windows and external doors cannot be opened with convenience, then the doors to each room may be set ajar, the stove registers thrown back, and the inlets opened, so that some sort of circulation may be established.

The position of doors and windows will, of course, have an effect upon the efficient airing of a room. A window at each end of the apartment provides effectual means for a through current, but this is

not always a possible arrangement. The door, in common with the window, should be regarded as a means of airing, and the door can be so placed and hinged that a current of air may be directed over the whole, or a greater part, of the room when desired. Doors so placed will give the greatest freedom from draught, as the stream in its extended journey is broken up and diffused. Doors placed immediately opposite the fireplace are in the worst possible position; a situation near to one corner of the room, with the door so hung that it swings back toward the fireplace, is much better.

The airing of staircases and passages is a matter which presents greater difficulties than the ventilation of a single room, especially in winter-time, when the admission of large quantities of cold air is out of the question. A fanlight with a protecting grille or grating arranged over, or ventilating panels in the entrance door of vestibule or hall, is an excellent arrangement for summer, especially if the staircase has a lantern light or other means of ventilation at the top; but the difficulty of heating the incoming air is a serious bar to such means of airing in colder weather.

Chimney. Since the chimney is the only outlet generally provided, it is of the utmost importance that this channel should be kept clear of obstructions, and no room without an open fireplace is fit for human occupation. The practice of closing the register plate when a down draught is experienced is to be strongly discouraged. It is so easy to forget to open it again when the wind changes, and the grate is kept so much cleaner when it is down. Indeed, the fancy of some people will detect a down draught at all times, whatever may be the direction of the wind or the state of the weather. No great amount of unpleasantness from sooty smells will be noticed from such a draught if the flue is kept well swept, and even the sooty odour had better be endured than the stale smell of humanity which is peculiar to the stagnant air of many apartments.

Chimney-board. The chimney-board so dear to the souls of some particularly tidy housekeepers, and such an essential item in many a bedroom, should be condemned to destruction without hesitation, to prevent the probability of even occasional use. Not content with merely masking the opening of the fireplace with such a contrivance, we may often see it carefully papered over so that the whole chimney is effectually sealed.

If genuine discomfort is at times experienced from a down draught, a small screen stood around the fireplace will deflect the current and prevent it playing directly upon the bed or the occupants of the room;

but the adoption of the Hinckes-Bird method of fresh air admittance to all bedrooms will go far to minimise such troubles.

Night Air. The admittance of the external air at night need not be feared, for in all probability it is purer than it has been during any part of the day. The cooler, fresher atmosphere of the room will be conducive to sound and refreshing sleep, and less chance of contracting colds will be encountered in sleeping in such an atmosphere than in the stale air which distresses and weakens the respiratory organs. If the night is foggy, a slip of muslin fixed over the space between the sashes will filter the air from deleterious matter.

Opening Windows. In opening windows for airing, remember to open them widely both top and bottom. The vitiated air will pass out at the top, and fresh air will enter at the bottom. If the window is opened only a few inches at the bottom we have a stratum of air in the upper part of the room undisturbed, and this air in a bedroom which has been occupied all night with the windows closed is in a foul condition and must be replaced.

If the window blind is not drawn up clear when the window is opened there is very little use in opening the window. Appearances should be disregarded and the blind drawn up hard to the roller, and the window then opened. Venetian blinds, of course, act like louvres, and will pass a great volume of air when drawn if the laths are turned in the proper direction.

Section VI.—Warming the Home

CHAPTER XIII

FIREPLACES, GAS AND OIL STOVES

"I like a sea-coal fire, if not too dear."—Byron.

Open Fire.

The British prejudice in favour of the open fireplace is likely to retain its hold upon the nation in spite of its waste of fuel, the dust and dirt it occasions, and the discomfort arising from the draught that it creates. Tradition associates the open fire with the open heart, and our hearth stands as a symbol of that hospitality which is characteristic of the race. Although its disadvantages are great, its virtues are considerable, and as a means of ventilation its value is not to be over-estimated, whilst its cheerful influence in the home is of no little importance.

The amount of heat given out by the open fire is directly dependent on the area of heated surface, which radiates or throws off its heat into the room. The loss of heat owing to the grate being immediately under the flue, and the thin material of which all radiating surfaces of the old pattern stoves are constructed, has led to the production of new types which are designed for more economic and effectual service. In these the fire-basket is brought forward and the old cast-iron back and cheeks are replaced by heavy fire-clay tiles fixed at such angles that the utmost advantage shall be obtained from their radiation. Economy is further effected by substituting a solid fire-tile for the hearth grating or stove bottom, or by enclosing the space underneath the grate by a movable fret, and so cutting off a large and wasteful supply of air to the fire.

Other designs go to the very verge of primitive simplicity, and the fire is situated upon the hearth itself with the merest semblance of an enclosure representing the fire-basket — in fact, the variety of slow combustion and ideal fireplaces put upon the market during the last few years is almost bewildering to the would-be purchaser.

Teale Type. The Teale grate, upon which so many subsequent designs have been modelled, is constructed with heavy fire-clay cheeks converging toward the back of the stove, and a forward-inclined back of the same material, presenting a large heating surface to the action of the fire and an increased radiation into the room. The Boyd grate, "Well Fire," "Devon Fire," "Bush Fire," "Heaped Fire," "The Draw-well Fire," and others have similar characteristics and differ chiefly in their artistic and attractive settings; but for the greater part all agree in keeping the fire low toward the hearth and effect economy and efficiency by heavy fire-clay construction and slow combustion.

As early as the end of the eighteenth century Count Rumford called attention to the wasteful consumption of household fuel, and suggested more simple and economical methods of fireplace construction.

This was followed up many years after by Sir Douglas Galton and others, but until Mr. Teale stirred in the matter thirty years ago very little advance was made in the adoption of the much-desired improvements, and, save for a solitary example here and there, the result of pioneer efforts, nothing was known of the recommendations, which, coming from men so well qualified to advise upon such matters, should have attracted wide attention.

Mr. Teale, in his lecture at the Royal Institution in 1886, set forth the following principles which should characterise the improved fireplace:—

As little iron as possible (essentially the bars and fire-grate only).

Back and sides of the fireplace to be of fire-brick.

Back of fireplace should lean over the fire (the angle of inclination being from 60 to 70 degrees with the fire-grate).

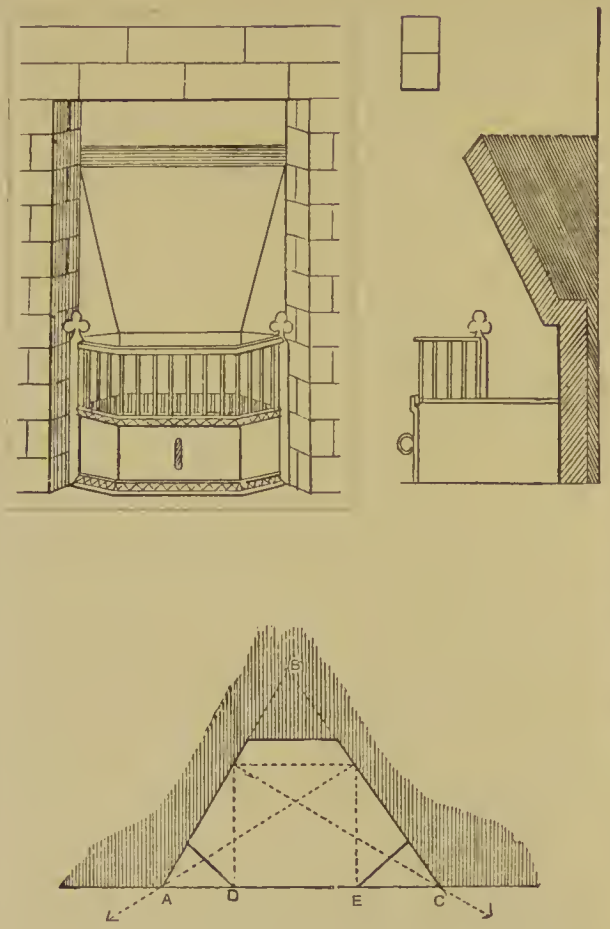
The sides of the fireplace should be vertical, but converging toward each other at the back.

The spaces between the bars of the fire-grate should be narrow, from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch.

The front bars should be vertical and narrow, $\frac{1}{4}$ inch in diameter and $\frac{3}{4}$ inch apart.

The chamber under the fire (space between fire-grate and hearth) should be enclosed by a door or shield, termed by Mr. Teale an "economiser." This should be of stout cast-iron or glazed fire-clay.

The bottom of the fire, that is, across the fire-grate, should be from 9 to 11 inches deep from front to back, according to size of room.



PRINCIPLES OF THE TEALE GRATE

TYPE OF TEALE FIREPLACE

In Mr. Teale's constructive plan it will be seen that the form of the fireplace is based upon an equilateral triangle, A, B, C, the two sides of which are represented by the cheeks and the base by the front of the stove, one-third of the depth of the triangle being cut off at its apex by the position of the fire-back, while the front is returned at an angle of 45 degrees at D and E.

This explanation will probably be made clearer by reference to the illustration, showing vertical section and front view of the fireplace.

The advantages claimed for this construction are, broadly, great economy in fuel consumption, increased heat, less smoke, less dust, less ashes.

In the first place, it is argued that a sharp draught through the bottom of the fire causes a too rapid and impartial heating of the fuel, during which much of the gas and inflammable vapour is carried up the chimney before it has a chance to burn, and the grate becomes choked with half-burnt fuel or cinders, necessitating frequent stirring to clear the fire. The result is great waste, due to imperfect combustion and repeated stirring, a large amount of ashes and cinders, and consequently much dust wafted about the room, beside the sooting up of the chimney by the quantity of smoke produced. On the other hand, if draught is cut off by a shield or fret closing the space beneath the grate, the gases rise more slowly and are more completely consumed, thus producing less smoke, and consequently less soot.

This, of course, is more completely accomplished when the fire has warmed up the surrounding box of fire-clay.

The warm space beneath the grate tends to keep the grate and the fuel at the bottom of the fire at an even temperature all over, which is conducive to more perfect combustion—hence less ash is produced, the mended fire quickly recovers, even when allowed to get very low before being attended to, and little or no stirring is required at any time. Incidentally, the slow combustion demanding much less air, the draughts caused by the pull of the fire are greatly reduced.

Increased warmth is obtained by radiation from the thick fire-clay converging cheeks and the overhanging back, which intercept and absorb the maximum amount of heat.

This explanation of the Teale fireplace is given as an example of a well-thought-out modern fireplace; but, as already pointed out, there are other makes which have many excellent points.

It is obvious that the use of a grating for the bottom of a fire has a distinct advantage over the solid fire-tile bottom, in that the

fine ashes automatically fall away, where in the latter case they form a bed at the bottom of the fire which has to be occasionally stirred out.

The principle of the economiser may be applied to any existing stove with advantage, the saving in fuel consumption by such a simple contrivance being estimated at from one-sixth to one-fourth of the quantity formerly used, while the resultant small amount of ash is equally surprising.

The space thus enclosed by the economiser beneath the kitchen stove may be utilised for drying vegetable and other refuse of a moist character to facilitate subsequent burning.

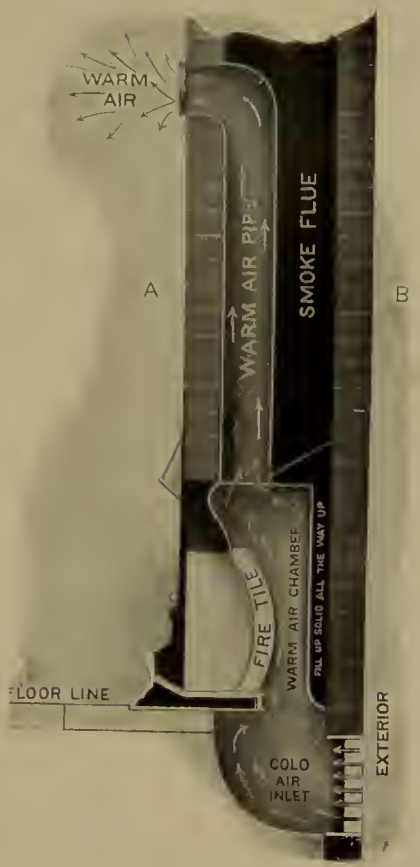
It has perhaps been sufficiently demonstrated that the roaring fire which writers are wont extravagantly to describe as "leaping half-way up the chimney" does not afford that amount of warmth and comfort which is experienced from the gentle glow of the modern grate, and he who was accustomed, with the old order of things, to sit by the fire, poker in hand, to lend it frequent vigorous assistance, must learn that the modern fire needs no goading, but will steadily perform its task until fresh fuel is required.

Its efficiency will not be improved by the most assiduous stirring, which can only result in waste of fuel.

The once formidable poker is now dwindled to a mere toy, whose purpose is to rake forward the embers to a level bed when the fire needs mending, and to arrange the fresh fuel in as even and compact a layer as possible over the grate.

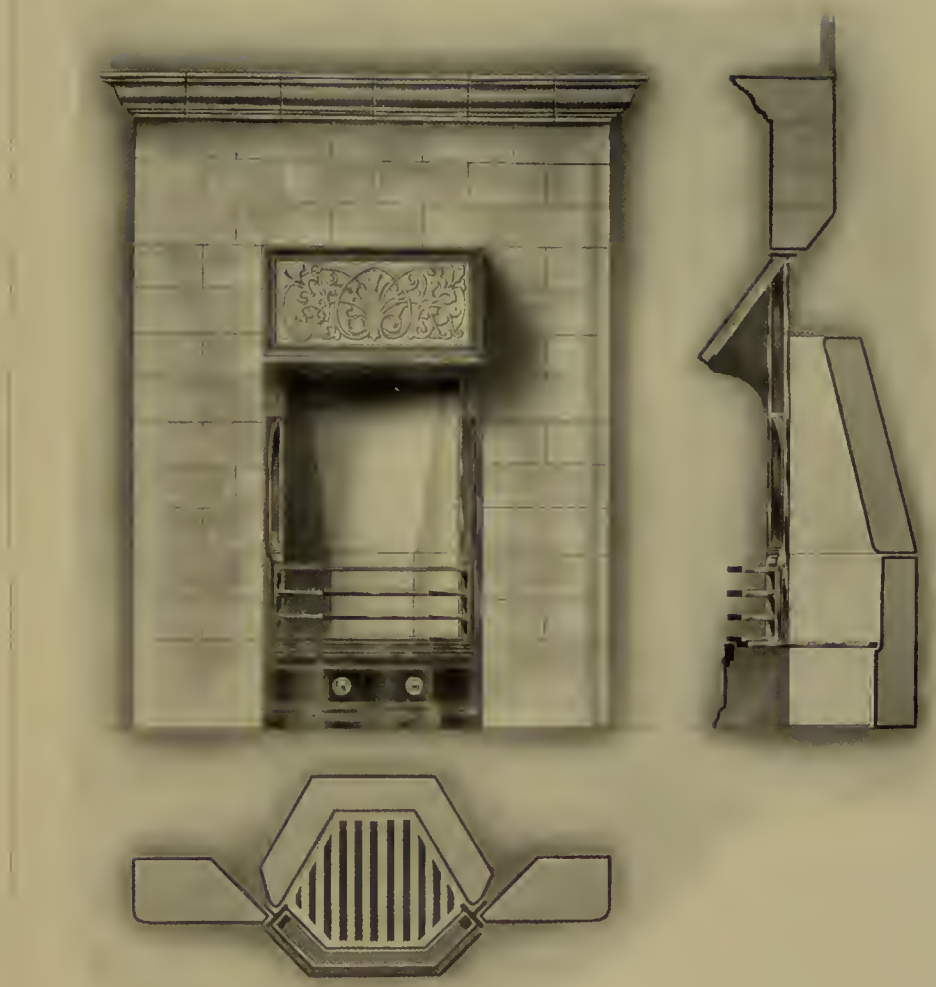
Ventilating Grate. There is no doubt that the most efficient type of grate or open fireplace yet invented is that which provides for the warming of the incoming air, and thus utilises a still greater percentage of the generated heat. Fresh air is conducted through rather large pipes from outside the building to warming chambers constructed at the back of the stove, from whence it is delivered through a grating, provided with a regulating shutter, into the room. These stoves are of the slow-combustion type, and the thick fire-clay walls in front of the warming chambers prevent the air from burning, and the liberal entry of warm air greatly reduces cold currents from doors and windows. The "Grundy" and the "Manchester" grate are well-known examples.

Closed Stoves. The stove proper, or box stove of the French and German types, and such as are so largely used in Canada and America, are perhaps more economical, and have a much greater heating power than the open fireplace; but as ventilating agents they are far inferior, and the apartments in which they are used quickly



SECTION OF "MANCHESTER" GRATE
SHOWING PRINCIPLE OF CONSTRUCTION

TYPES OF "MANCHESTER" GRATES



FRONT VIEW, PLAN, AND SECTION OF BURMANTOFT'S GRATE WITH GLAZED BRICK SETTING

become overheated. The large quantity of air which comes in contact with the highly heated surfaces of the stove and smoke-pipe is deprived of its moisture and becomes unfit for comfortable breathing, and even if this is counteracted by the provision of water-evaporating pans, the tiny particles of organic matter always present in air as dust are burnt, producing an atmosphere unpleasant to smell and irritating to the respiratory organs.

Gas Stoves and Fires.

Gas stoves are in such general use that a few words upon the subject are necessary, chiefly on account of the very real danger to health and often to life by their improper use and careless management. The mistaken impression that a flue is unnecessary because of the absence of smoke or any visible by-product of combustion is responsible for the unpleasant odour which advertises the use of such stoves in many households.

When gas fires are used in an open grate the register plate must be kept open, and it should be remembered that the heating efficiency depends upon much the same conditions as apply to the ordinary coal fire, that is the area of heat-radiating surface exposed. The gas flame should therefore be so directed that it is wholly absorbed or taken up by the asbestos or coke-filling of the grate, and as large an area as possible rendered incandescent. The appearance of large flames rising above the lumps indicates so much waste energy, and probably arises from the improper packing of the coke or asbestos, too great a pressure of gas, or faulty burners. At the best the gas stove is a poor substitute for the coal fire, and its comparative freedom from dirt and dust, and the convenience it affords for rapidly warming an apartment, are its only recommendations.

Cooking Stoves.

Gas cooking stoves should be fixed in a recess or under a hood provided with a suitable flue or pipe to carry off the poisonous compounds resulting from combustion. In fact, any gas heater or warmer, whatever may be claimed for it by the manufacturers, or however ingenious its construction, cannot dispose of these products, and a flue is absolutely essential for that purpose. The products of gas consumption consist of carbonic acid, nitrogen, water, and sulphurous acid.

With condensing stoves the sulphur compounds are carried down with the water produced by combustion, but the nitrogen and carbonic acid are not so dealt with, and an outlet for these gases is provided, but often so cunningly concealed that it is not easily perceived. The masking of this outlet is made possible by the fact that the escaping gases have neither colour nor smell.

A great point put forth in support of the contention that all products are consumed may be that the stove can be used in a greenhouse without danger to plants. The mere fact that the sulphur compounds are disposed of makes this possible.

Unpleasant smells from gas stoves may be caused by imperfect combustion of gas, defective flues, or dirty stoves.

The Bunsen burner with which such stoves are fitted has an open chamber at its base through which the gas passes, and as it passes a quantity of air is drawn in and mixed with the gas sufficient to insure the more or less complete combustion of its particles.

The gas flame appears at the extremity of the burner, and should never, as it is termed, "light back" at the mixing chamber. When this occurs an unpleasant smell arises, due to incomplete combustion. The cause may be faulty burners or choking by soot or grease.

Evil smells are also caused by a too close contact of the object being heated with the burners, which lowers the temperature of the flame and allows part of the gas to escape unconsumed. The tip of the flame should just touch the plate, kettle, or boiler. It is said that a ring or area of gas jets one-third of the area of the bottom of the vessel to be heated is the maximum required; anything beyond this is wasted.

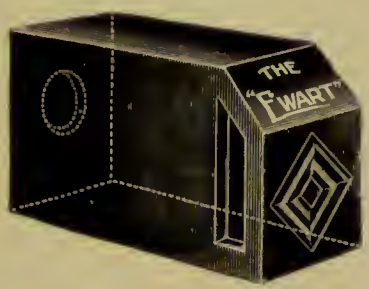
Geyser. The bathroom geyser, of all gas heaters, has been the greatest source of danger, and until some number of fatalities drew attention to the fact, the provision of a flue for this appliance was generally deemed quite superfluous; and still there are many to be met with which have either no flue at all or merely a pipe stuck through the wall, that under certain weather conditions is of no use whatever. What relates to the geyser holds good with respect to other forms of the gas stove, and it is only due to the fact that the majority of the latter are fixed in larger and more open apartments that similar serious results have not been occasioned by their use.

Products of Combustion. The influence of carbonic acid gas produced by combustion is so insidious that its first effects are often not recognised, the victim being merely affected by a feeling of languor which is probably ascribed to the comfortable heat of the room or bath. If the gas continues to be inhaled the languor increases until insensibility ensues, which ends in death unless help is speedily forthcoming.

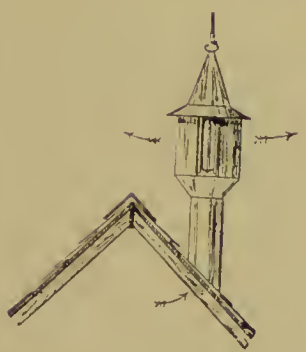
An experience of a personal friend of the writer in an hotel bathroom will show how easily such a fatality may occur. Desiring a warm bath, he lighted the geyser, which had no flue, closed the window to avoid draught, and when the bath was comfortably warmed gave

GEYSER FITTED OVER LAVATORY BASIN

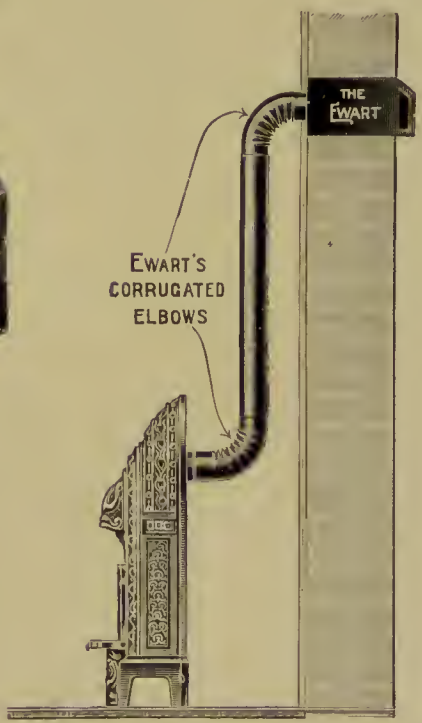
BAFFLE CHAMBER FOR GEYSER FLUE TO PREVENT BACK DRAUGHT



EWART'S OUTLET BLOCK FOR GEYSER FLUE



AIR PUMP COWL FOR GEYSER FLUE



APPLICATION OF OUTLET BLOCK

himself up to the luxurious feeling of enjoyment. After some little time he found himself slipping further down into the water and suddenly became aware that he was dozing. By a supreme effort he struggled to his feet and threw open the window, and thus averted what would undoubtedly have been another bathroom mystery.

Pipes or flues from gas heaters must be carried up outside the house to a sufficient height to ensure a draught, or, if necessary, capped with an extractor cowl of the Boyle air-pump pattern; but they must not deliver into the space beneath the roof, or into an ordinary flue unless a plate closes the opening below so that the return of the fumes into the room is impossible.

To ensure a proper outflow of the combustion gases the use of a baffler is always advisable. This is a cylindrical chamber of sheet metal which is inserted in the pipe flue within the apartment at the highest point of the flue, and is designed to counteract down-draught. The flue should, of course, be perfectly sound with regard to joints and proof against leakage of foul gases. The unsightly external appearance of the pipe sprouting from the wall may be avoided by using Ewart's outlet block, a hollow glazed stoneware chamber of small dimensions, which may be built into the wall, forming an effective and unobtrusive outlet, but the form of the outlet desired depends much upon its position, and upon aspect with regard to prevailing winds.

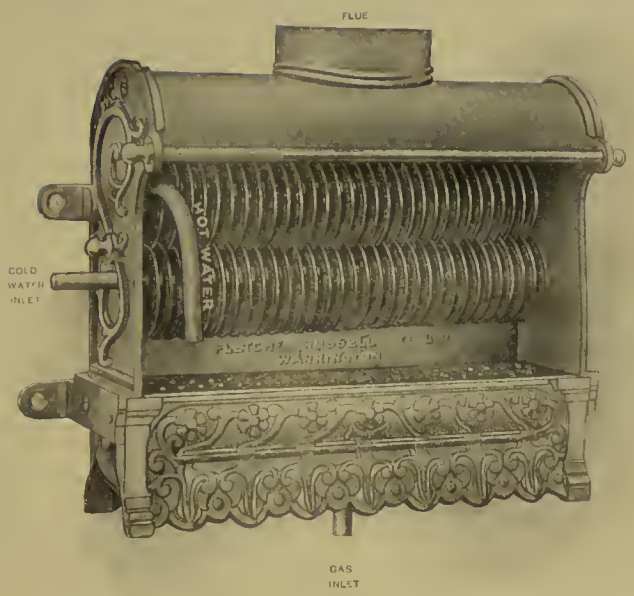
Oil Stoves. Oil stoves for warming and cooking are much used, but the attention they demand in trimming and burning militate against their larger adoption, especially where gas is to be obtained, although as portable warming stoves for occasional use they have gained some favour. With proper care and attention such stoves will render good service, but cleanliness is most necessary in relation to reservoir, wick, and burner. The first should be occasionally emptied, the oil strained, and the receptacle thoroughly cleansed with hot salt water or a strong solution of soda, and well dried before refilling. The wick should be washed in a similar solution and made bone dry before re-using, and the burner and all air passages kept brushed clean of dust and fragments of charred wick. Oil stoves should not be burned for long periods in closed rooms intended for immediate occupation or where persons are employed, unless some means are provided for carrying off the combustion by-products.

Oil geysers and heaters are made by such well-known firms as Ewart, Fenlon, Braby, etc., upon good principles, with wickless burners, and where gas is not to be had their use may be of the greatest service, but they require careful attention.

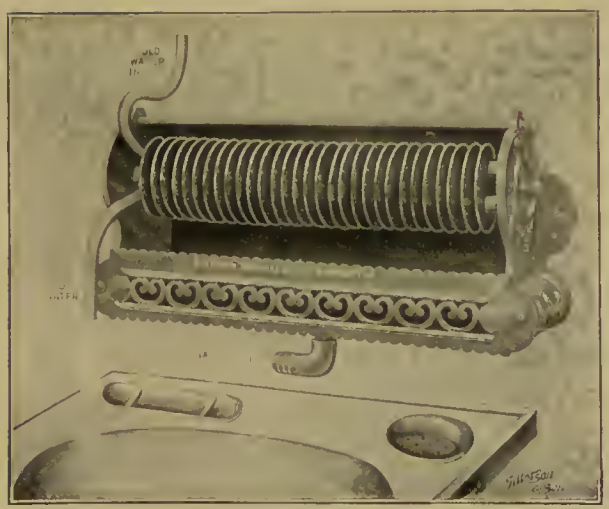
Water Heater. Where gas is to be obtained, small quantities of water for lavatory basin and general toilet purposes may be heated with Fletcher's Instantaneous Water Heater. This is a small coil connected with the water-supply and heated by a row of small gas jets beneath. The gas is lighted and the water turned on at once so that it flows in a small stream. The heating power is sufficient to produce a stream of sufficiently hot water for ordinary use in a very few seconds.

Even Temperature. It is not desirable to maintain a temperature of more than 60 to 65 degrees Fahrenheit in ordinary dwelling-rooms, and 55 degrees is usually sufficient for bedrooms, corridors, and passages. The sick-room and nursery may require a somewhat higher temperature at times, but this depends upon the age and condition of the occupants, though for ordinary healthy occupation the temperatures given above are amply sufficient for comfort and should not be exceeded.

The difficulty of obtaining any approach to equable temperature in all parts of a room is great, but to maintain a comfortable warmth throughout the house in winter is a matter of impossibility unless some means are adopted other than those that have been mentioned. The system of warming by heated air in which fresh air is conducted in large quantities through a special heating apparatus fixed in the basement, and delivered by flues or ducts into various parts of the house, is suitable only for very large establishments and need not be considered here.



FLETCHER'S "INSTANTANEOUS" WATER-HEATER



FLETCHER'S "INSTANTANEOUS" WATER-HEATER FOR LAVATORIES

OIL GEYSER

TYPES OF WATER-HEATERS

CHAPTER XIV

HOT-WATER SYSTEMS

"In winter, warmth stands for all virtue."—THOREAU.

THE notion of warming by the circulation of steam or hot water carried through iron pipes, traversing the apartments and presenting a radiating surface proportioned to the space to be heated, has produced many systems, each of which has its advantages and each its disadvantages. Steam, for numerous reasons, is out of the question for ordinary domestic use, and a high-pressure hot-water circulation, although most effective and neat in appearance, is liable to overheat and burn the air, and unless the system has skilled attention it is apt to be noisy. From all-round considerations low-pressure hot-water systems would appear to be the most suitable for the home. The usual systems to be found installed in the ordinary house are the "cylinder" system and the "tank" or "hot cistern" system.

Cylinder System. In the cylinder system (see diagram, page 123) the boiler is usually fixed at the back of, and is heated by, the kitchen range, although in some cases, particularly in large houses, an independent boiler is fixed. A copper cylinder is placed as near to the boiler as convenient, usually in a cupboard in the kitchen or the room adjoining, and a supply cistern, fed from the main, is fixed at the top of the house. The cold-water supply from the cistern enters the cylinder near the bottom, and the boiler supply is carried out on the other side at the same level, the return or flow pipe from the boiler entering the cylinder at a higher level. From the top of the cylinder is carried an expansion pipe, which is turned over the top of the water cistern and terminates in an open end. Branches from this expansion pipe are led off for supply and warming purposes, finally returning to the cylinder to complete the circulation.

Tank System. The "tank" system (see diagram, page 124) is a much cheaper arrangement, in which the tank serves the purpose of the cylinder. The tank is usually situated at some distance from the boiler, and when placed side by side or on a level with the supply cistern is sometimes fitted with a loose cover and becomes

merely a hot cistern; but more often the tank is of closed or box form, fitted with an expansion pipe, and may be situated below the level of the supply cistern. The flow pipes are carried off between the boiler and the tank.

The disadvantages of the latter system lie chiefly in the length of the circulating pipes from boiler to tank, which are liable to freeze, and the possibility of the tank being emptied when the water-supply is off. The pressure is then increased to a dangerous degree by the suspension of circulation.

The former system has its drawbacks, and we occasionally hear of the explosion of a boiler or the collapse of a cylinder, though, fortunately, this is of rare occurrence. Boilers are sometimes fitted with safety valves or fusible plugs, but absolute reliance upon such safeguards is unwise, to say the least. The explosion of a boiler is caused by the stoppage of the circulation, which may be due to freezing of the circulating pipes between the cylinder and boiler, or other circulating pipes, or stoppage of the flow due to incrustation. Cylinder collapse may result from stoppage or freezing of the expansion pipe, or the too great length of such pipe, when the weight of the column of water it contains overpowers the column in the supply pipe and causes a sudden reverse of pressure.

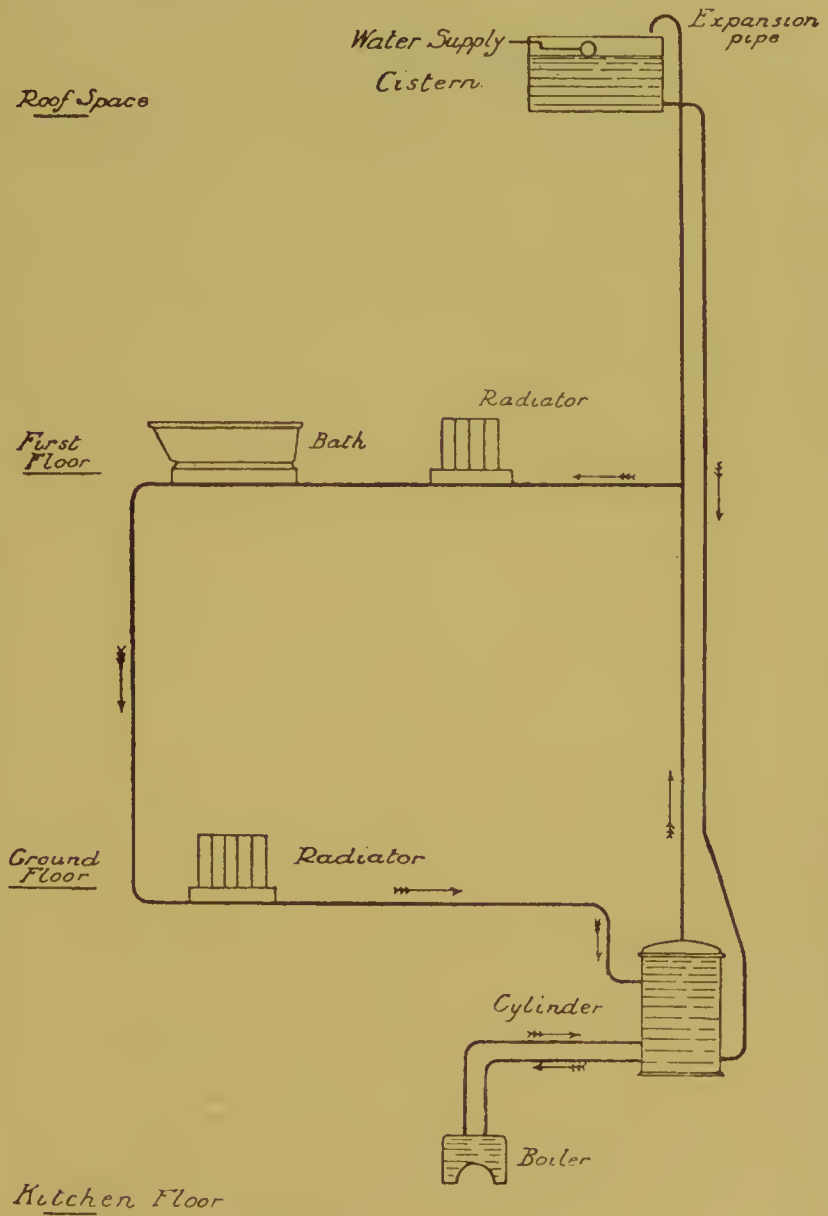
It is well to remember that a constant and free circulation is the best safeguard against accidents, and that a suspension, or check, to this raises the pressure in pipes and boiler to a very considerable degree. Warning of pipe corrosion is indicated by a poor or diminished supply obtainable at draw-off taps. Boiler incrustation may be checked to a very large extent by the use of the so-called "Octopus," which is kept in the boiler and collects the fur or deposit from the water. Occasional cleaning-out of boiler and cylinder and examination of pipes is very necessary.

Double Cylinder. The double-cylinder system (see diagram, page 127) is an elaboration of and improvement upon the ordinary or single-cylinder method, and although it has its disadvantages, inasmuch as the water is not so highly and perfectly heated, it has the one paramount virtue of being absolutely proof against boiler explosions or cylinder collapse.

The improvement consists in placing one cylinder inside another, with a considerable space between the two for circulation. One cylinder is connected to the boiler by flow and return pipes, and merely acts as a heating agent for the water contained in the other cylinder, which furnishes the supply for warming and domestic purposes. The main

HEATING AND HOT WATER SUPPLY — No. 1

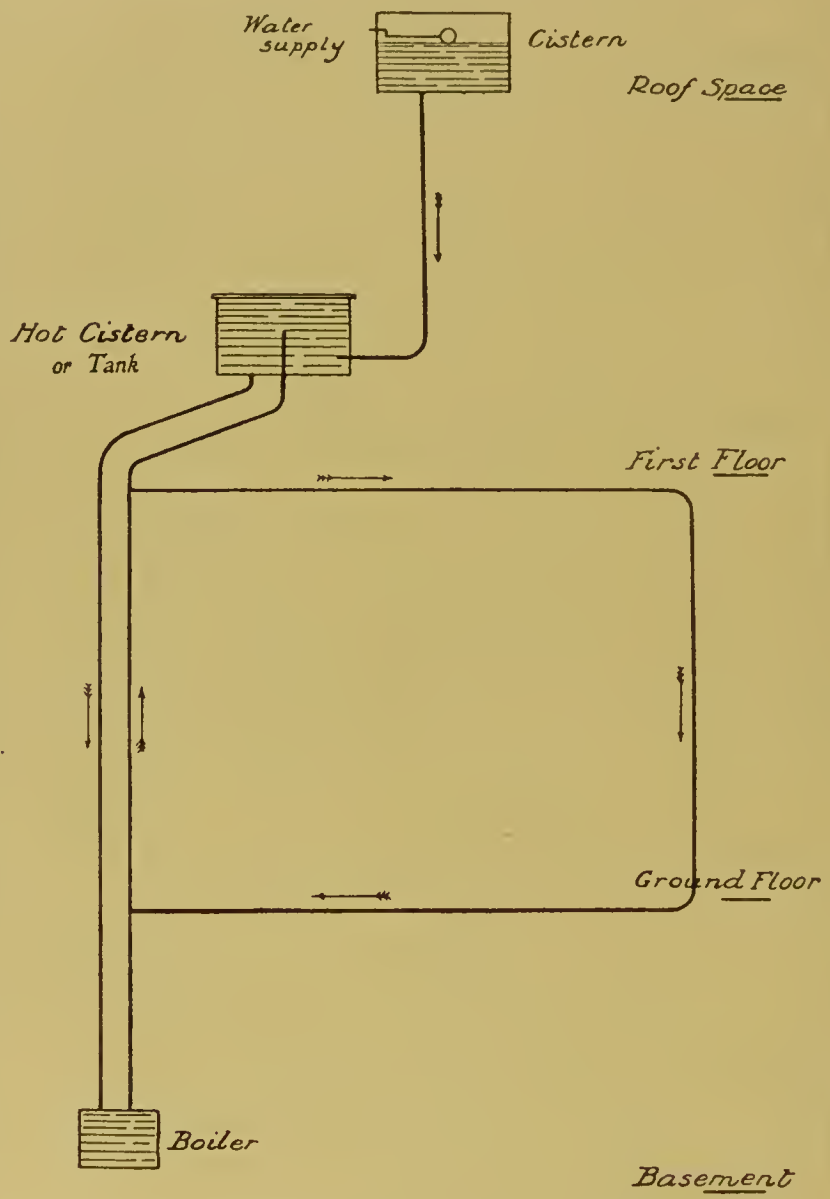
DIAGRAM OF SINGLE CYLINDER SYSTEM



Arrows indicate course of Circulation

HEATING AND HOT WATER SUPPLY No. 2

DIAGRAM OF HOT TANK SYSTEM.



Arrows indicate course of Circulation

cistern feeds one cylinder, and a smaller cistern connected to the main cistern feeds the boiler. Each cylinder has its own expansion pipe, and a similar pipe is fitted to the boiler.

Circulation between the various parts is easily understood. In the one case the water circulates between boiler and cylinder No. 1, and is not drawn upon for any other purpose, and in the other case from cylinder No. 2, round the circuit of warming and supply pipes, and back to cylinder again. A modification of the above system substitutes a coil for the heating cylinder.

Low-pressure water systems, intended for warming only, require no circulating cylinder, and the loss of water is so small that the supply is readily adjusted by a small feeding cistern, which may also act as an expansion tank.

Radiators. The very serious objection to the unsightly appearance of the quantity of circulating pipe required to give the necessary radiating surface needed for warming a given space is met by the provision of radiators or coils which may be placed in convenient positions and, whilst occupying a minimum of space, give the requisite area of radiating surface. These may be obtained in ornamental castings, masked by casings of wood or metal, or rendered unobtrusive by numerous ingenious devices. By the agency of these fittings the radiating pipe area may be so distributed about the room that a larger proportion is assigned to the colder parts, such as beneath windows, against external walls, etc., thus ensuring an equable temperature in all parts. They may also be placed at fresh-air inlets to warm the stream of air as it enters.

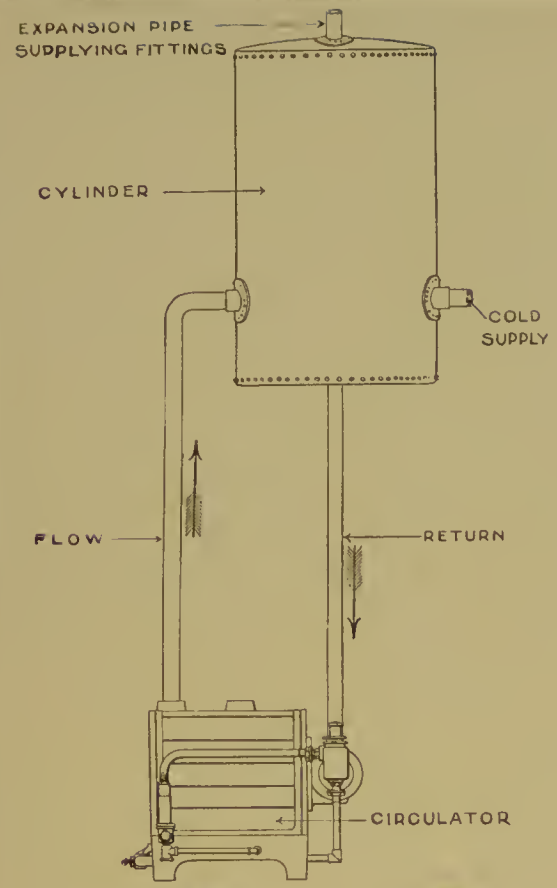
The most serviceable form of radiator is that in which the tubes or loops are placed vertically and fairly wide apart, and the whole set well up off the floor upon suitable feet so that it is possible without much trouble to keep it free from dust. The fitting should also be kept far enough away from the wall to give sufficient space for cleaning. To avoid accumulation of dust upon and around the radiator, all parts should be carefully and frequently brushed, particularly between the loops and underneath and behind the fitting.

Radiators are of great assistance as auxiliary heating agents to the open fire, by placing them in window recesses, beneath the window, in corridors, vestibules, the hall, dressing-rooms, bedrooms, bathrooms, etc., in the form of the radiator pure and simple, or as towel-rails, clothes-airing racks, etc. A simple and comparatively inexpensive instalment for this purpose can be obtained (see diagram, page 128), consisting of a specially made coil to fit the back of the ordinary open

fire, from which pipes are led to one or more radiators in and about the room, or in the bedroom above, or in an adjacent conservatory. This coil, which is known as "Prior's Patent Heat Distributor," is strongly made of copper tubing designed to resist rough usage.

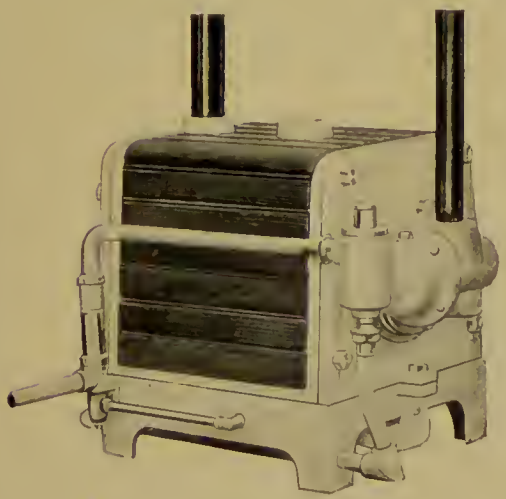
The diagram on page 128 also shows an excellent arrangement in the "Venetian" boiler stove, which can be used as an open fire, or closed to accelerate the heating of water.

The "Davis" gilled water heater is designed to perform the service usually rendered by the boiler at the back of the kitchen stove, and is fitted in the manner shown in illustrations. This gas heater is said to be very much more powerful than those of the "Geyser" type which are often used for this purpose.

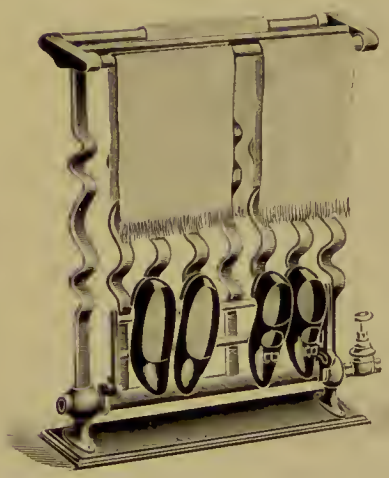


VENETIAN FLUED BOILER GRATE AS A CLOSED BOILER FURNACE

VENETIAN FLUED BOILER GRATE AS A SITTING-ROOM FIRE

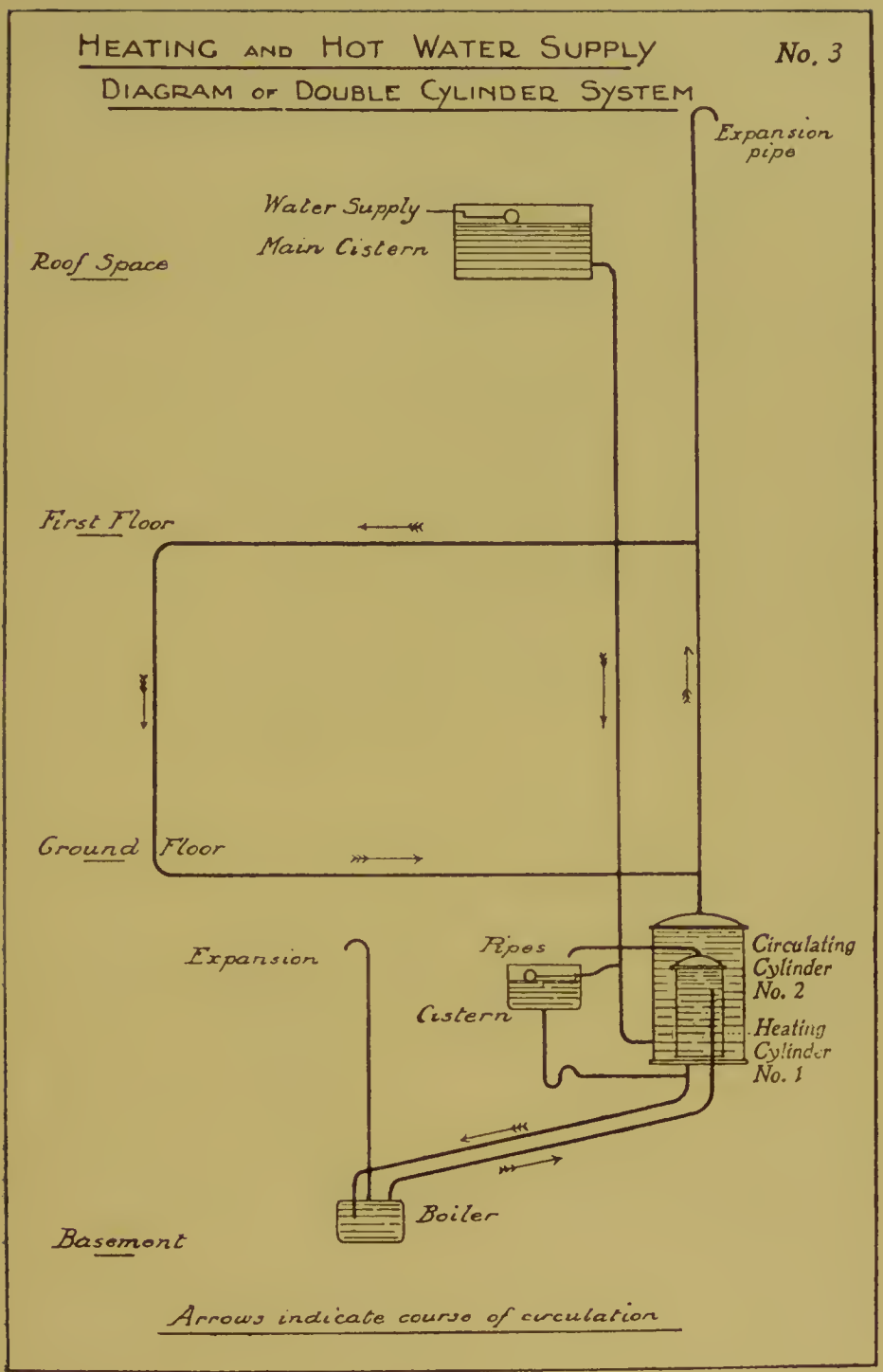


GAS-HEATED GILLED CIRCULATOR, SHOWING APPLICATION



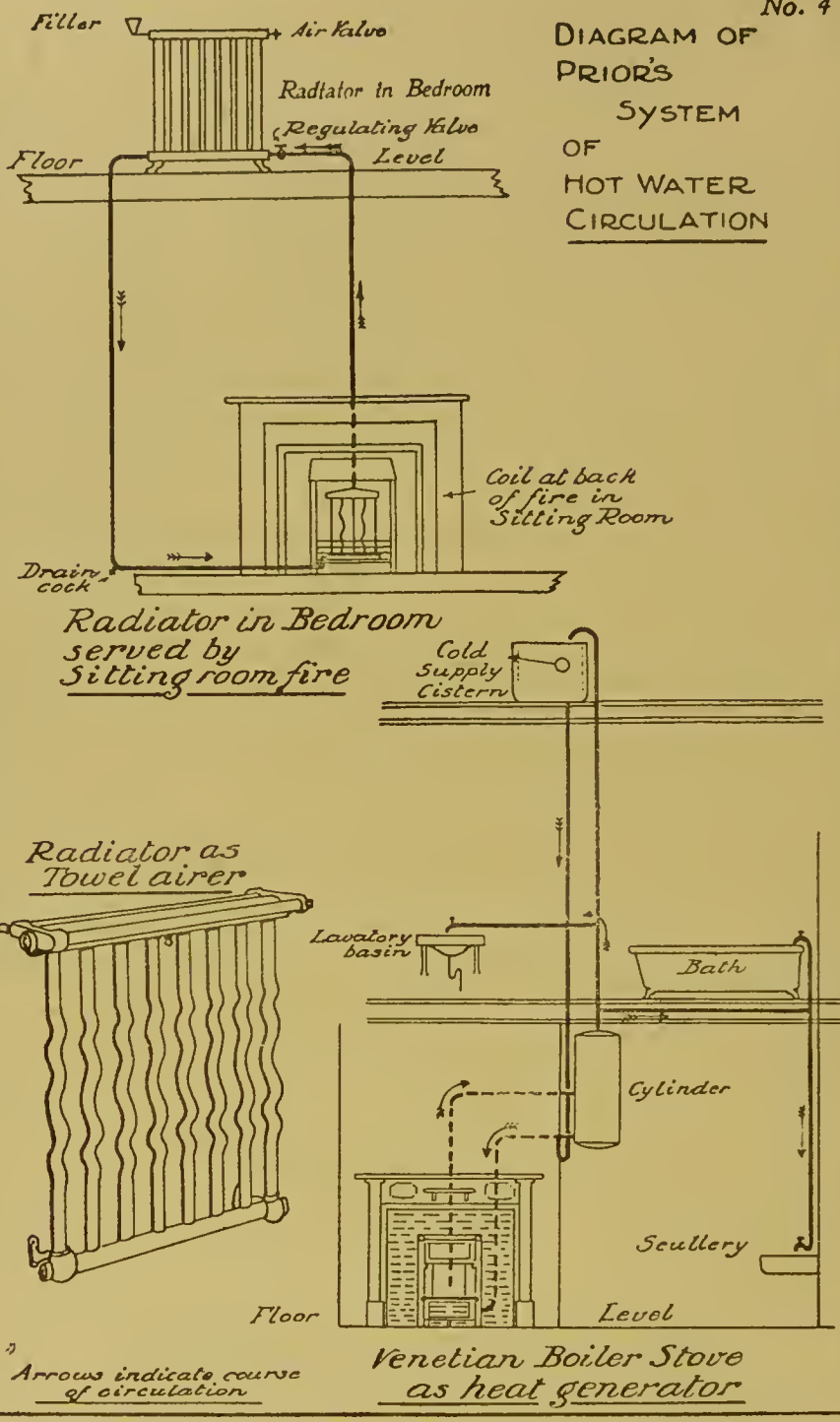
VENETIAN RADIATOR AS TOWEL-AIRER

TYPES OF WATER-HEATERS


HEATING AND HOT WATER SUPPLY
No. 3
DIAGRAM OF DOUBLE CYLINDER SYSTEM
Expansion pipe
Water Supply
Main Cistern
Roof Space
First Floor
Ground Floor
Expansion
Pipes
Cistern
Circulating Cylinder No. 2
Heating Cylinder No. 1
Boiler
Basement
Arrows indicate course of circulation

No. 4

DIAGRAM OF PRIOR'S SYSTEM OF HOT WATER CIRCULATION



CHAPTER XV

FIRE PREVENTION AND EXTINGUISHING APPLIANCES

"A little fire is quickly trodden out;
Which being suffer'd, rivers cannot quench."
—SHAKESPEARE.

A REASONABLE fear of fire is a safeguard against disaster, but dread leads many people to the pursuit of practices which really increase the chances of an outbreak, while, on the other hand, others are guilty of culpable negligence of the most ordinary precautions and seem to court the danger which often by the merest chance they escape.

Some people insist upon raking out every scrap of fire from the grate on to the hearth before retiring to bed, through fear of live coals flying out into the room, whereas there is in the operation very grave risk of scattering some of the fire dangerously near to combustible material. The safest place to leave the remnants of the fire is in the grate constructed to retain it. If a rather large fire is left, a reasonable precaution is to stand in the hearth or hang on the fire-bars one of the small wire guards sold for this purpose, which will be quite sufficient to arrest the passage of any fire which may shoot outward.

Other prudent souls desirous of "taking time by the forelock," not only rake out the embers, but proceed to lay the foundation for the morrow's fire in the still warm grate with the not infrequent result that the kindling becomes sufficiently heated in a short time to take fire and scatter sparks around when no one is about.

Fenders. No fireplace should be used as such without a fender of some serviceable description. The addition of an ash-pan to the ordinary grate is both useful and ornamental, and answers the purpose of keeping the ashes and cinders that fall from the grate out of sight and within safe bounds, but a good fender is always a necessary supplement to this.

Guards. All nursery or sick-room grates should be protected by a guard of wire woven on an iron frame firmly fixed in position by some means which are proof against the meddling of children.

This guard should be about 3 feet in height, of sufficient size to enclose the fender and, where there are small children about, the meshes of the wire should be sufficiently close to prevent toys or paper being thrust through them to the fire.

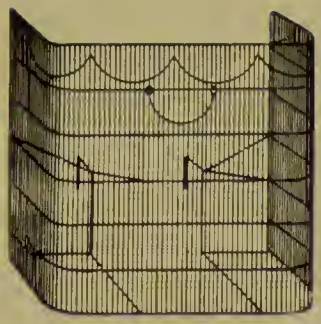
It should be distinctly understood that the practice of airing clothes by hanging them upon the guard is not to be encouraged, particularly in nurseries or in any rooms where children are likely to remain even for a short time unattended, as there is always the possibility of a calamity from some unexpected happening.

Foul Chimneys. Fires are sometimes occasioned by allowing chimneys to remain for a long time unswept. Flues may be defective, especially in very old houses, and the firing of a large accumulation of soot may easily culminate in setting fire to the building, by overheating the flue and firing adjacent woodwork.

The space around a register stove should be filled in solidly with brickwork, otherwise soot collects in places from whence it is impracticable to remove it. Such voids are sometimes left at the sides of the stove adjoining the mantel jambs, which soon become partially filled with soot. When the chimney is foul, a very little blaze ascending the flue ignites the soot and the burning is extended to all such accumulations—then, if the mantelpiece is of wood, there is every likelihood of its taking fire.

Firing a chimney to save the trouble or expense of a sweep's services may prove to be a costly experiment for the householder in other ways than the payment of the fine which is exacted in many towns for what is properly considered as a public offence. And in addition to the danger of fire the heat created by the firing destroys the plastering inside the flue and leaves the channel rough and more liable to collect soot in bunches, which retard the draught and fall at inconvenient times, while the chimney-pot is often broken by the excessive heat and may fall, with disastrous results to members of the household or some unfortunate wayfarer.

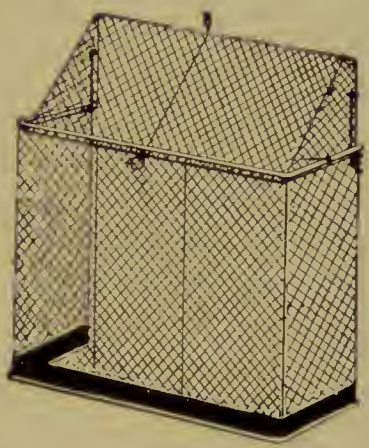
Pipe Stoves. Pipe stoves or boilers, i.e. stoves from which the smoke is carried off by metal pipe flues, require careful fixing and periodical examination. The stove, in the first instance, should be stood upon a stone or slate base of sufficient area to accommodate the ash-pan or to receive any ashes which may fall from the furnace, and it should be kept at least 18 inches away from any woodwork which may be near to the sides or back of the stove.



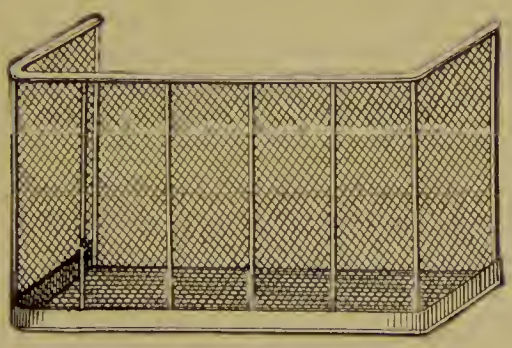
SPARK-PROOF GUARD

NURSERY FIRE-GUARD, WITH ADJUSTABLE HOOD TO PREVENT ACCESS TO FIRE OVER THE TOP OF THE GUARD

LIGHT-MADE NURSERY OR KITCHEN FIRE-GUARD



THE HOOD RAISED



FINE MESH NURSERY FIRE-GUARD

SCREEN GUARD FOR LOW GRATE

TYPES OF FIRE-GUARDS

The flue pipe should be of sheet iron, with properly made joints, and not of cast iron, and this should not be carried nearer than 9 inches to any woodwork. When the flue passes through a wooden partition or wood-lined wall, the pipe should be carried through a tube of stoneware which is large enough to allow of 1 inch clear space all round the flue for cooling; this may be closed against the weather by a sheet-iron plate fitting close to the flue on the outside of the wall. Sharp bends in the flue pipe should be avoided, as they form lodgment for soot and retard the passage of the escaping gases.

Woodwork near to a stove or flue-pipe may be covered with "Uralite," asbestos, or "Eternite" boards, which may be coloured to taste with water-paint or washable distemper. Metal sheeting is of very little use when nailed close to the woodwork, as it is a ready conductor of heat and quickly becomes heated through. If metal be used, a space for circulation of air should be left between the metal and woodwork or a packing of 1 inch to 2 inches of slag wool (silicate cotton), or asbestos, placed between metal and woodwork.

Portable Stoves. Small warming-stoves are often deemed safe when stood upon a wood floor with a thin sheet of iron beneath them, but the fallacy of this needs little discernment. The substance required is a non-conducting material, and a slate slab 1 inch in thickness need not be unsightly.

Portable oil and gas stoves are frequently placed in the most perilous positions, with no protection against the possibility of accidental overturning or being upset, or the danger of setting fire to the clothing of ladies or children who may pass too near to them.

Small circular guards may be obtained for enclosing oil stoves which are necessarily placed in exposed positions, and gas-flame warming stoves may be protected by woven wire guards of attractive appearance that fit over the front of the stove.

Hot-water pipes are best kept 3 inches clear of wood, unless it be protected by asbestos board or some similar non-conductor of heat.

Gas. Where coal-gas is used, considerable danger sometimes exists from habits of carelessness bred by everyday familiarity. Accidents are not always avoidable, but if the character of the illuminant were generally better understood mishaps from gas explosion would be very much less frequent.

Explosion occurs when a flame reaches a mixture of coal-gas and air, and but a comparatively small percentage of gas, 5 to 10 per cent., is required to make the most explosive composition. A small escape

in a closed room would produce this condition in a short time and it is therefore evident that apparently trivial defects demand prompt attention, and no escape, however faintly perceptible, should be allowed to go unchallenged.

Gas Fittings.

The telescopic, or water-slide, gasolier, which requires the occasional re-filling of the outer tube with water, is a constant source of danger, and cup and ball joints frequently become worn and leak to some extent when the fitting is swung out of the perpendicular. In fact, all fittings have some movable parts liable to wear, and therefore require occasional examination for needed repair.

The small pipes supplying brackets and pendants are usually carried under floors and embedded in the plaster of the walls for the sake of appearance. If the pipes are of iron there is very little fault to be found, as a rule, but frequently they are formed of a soft, lead-like material known among plumbers as "compo," through which nails may be inadvertently driven, either by the workmen nailing down the floors or by the householder in fixing chimney glasses or other wall decorations, and leaks are caused which are extremely difficult to locate.

"Compo" pipes should be fixed on the surface and well fastened with pipe hooks so that they cannot sag.

The floor-boards which cover the gas pipes and are usually called "gas boards," should not be nailed down, as removal for examination or alteration may be necessary. If they are screwed down, the run of the pipes is marked, the boards are easily taken up, and there is less danger of injuring the pipes by the more violent and haphazard process of nailing.

The custom of some economists of turning the gas off at the meter when the family go to rest is a dangerous practice, and is often the cause of misfortune. The mode of procedure is usually to leave one or more burners alight during the operation to exhaust the pipes and to prove that the job has been effectually accomplished, and the operator either does not trouble to turn off the taps when the gas burns out, or overlooks one. At any rate, he can never be sure that the occupants of bedrooms have turned off their taps when the supply is cut off in this manner.

Some other person turns on the gas in the morning, with no knowledge, possibly, of what has actually been done the night before: the result being that some time later an alarming and destructive explosion occurs.

This has happened scores of times, and is liable to occur in any household, however methodical, where this practice exists.

Every gas tap should be fitted with a stop-pin, so that it is impossible to turn the plug completely round; one is then sure that when the tap is turned hard against the pin the gas is off. Every tap is originally fitted with a stop of this sort, but hard usage occasionally causes them to break off or work loose and fall out.

Gas brackets are often fixed in dangerous positions in bedrooms, especially when placed close to the window, where an incoming draught may blow the curtains over the lighted burner. Swing brackets, too, are frequently placed so that it is possible for them to be pushed back against curtains or under shelves.

Unsafe Decoration. A taste for artistic effect, real or imaginary, leads to much draping with art needlework and other materials of anything which can possibly be so treated, and the most unexpected objects are seized upon to gratify this fancy, in a manner which is often truly absurd.

Walls are hung with light, inflammable fabrics or profusely decorated with articles wrought in paper and feathers, muslin is wound round gas fittings, lamps are adorned with elaborate shades of silk and lace, and even the fireplace may be seen curtained round and decorated like a shrine.

It would seem to a common-sense observer that some of the people who do this either have infinite faith in their good fortune or desire nothing so much as a fire.

First Aid. Most outbreaks of fire are discovered soon enough to be easily suppressed if suitable means are at hand for the purpose, and provided that the user has sufficient confidence to act calmly. Very few houses, however, are equipped against such a contingency, and emergency invariably finds them wholly unprepared and practically in the position of unarmed opponents at the mercy of a remorseless foe.

In the first stages of a fire water may be difficult to obtain in sufficient quantity and with the promptitude that the occasion requires, and it is, moreover, thrown more or less at random, with less effect in subduing the outbreak than in damaging the household goods. As a fact, considerably more damage is usually done by the water used than by the actual fire.

Chemical Extinction. The most effective and economical means of defence are chemical extinguishers, which accomplish their purpose by producing a dense volume of harmless, non-combustible gas that smothers the fire. These are easy to handle, occupy

but very little space, and can therefore be kept in places where they are ready to hand at any moment, which is an all-important consideration.

The principal forms are :—

1. The hand grenade, formed of a sealed glass bottle, containing a strong solution of salts, which has to be thrown with sufficient force at the seat of fire to break the vessel and scatter the contents.

2. A metal tube filled with a similar solution, which is held in the hand and the contents shaken or sprinkled on to the fire.

3. Vessels which work under pressure of the gas generated within them and expel the solution through a tube or nozzle, on the principle of the soda-water siphon.

4. Dry powders, which are scattered from a tube and evolve gases upon coming in contact with fire.

The hand grenade is objectionable for home use, inasmuch as a direct aim is required to effect its purpose, and personal injury is likely to result from wild throwing in the heat of excitement, to say nothing of the scattering of broken glass which will possibly be trampled upon by bare feet.

The tube, unless calmly used, is likely to be emptied anywhere but in the direction desired, and is soon spent.

The mixture for filling grenades and tubes is as follows :—

Common salt	1 drachm
Nitrate of soda	1 drachm
Sal ammoniac	2 drachms
Chloride of magnesium	4 drachms

Put the salts into an ordinary wine bottle, fill up with water, and shake until all are dissolved.

The third form of extinguisher can, however, be applied with a greater degree of safety and precision, as the charge is not immediately exhausted, and with less risk of damage to goods.

The vessel is usually a copper cylinder closed with a screwed cap and provided with a nozzle or short length of hose, which is sometimes fitted with a tap for shutting off the delivery. The cylinder is filled with a solution of bi-carbonate of soda ($\frac{1}{2}$ lb. of this salt to 1 gallon of water), and in the neck of the vessel is suspended a metal cradle containing a sealed bottle of sulphuric acid, 1 fluid oz. to 1 gallon of water.

When required for use, a knob projecting from the top or the side of the vessel is struck with sufficient force to break the bottle or to pierce the capsule which seals it, and a violent effervescence is created which drives the liquid out in a frothy stream on to the flames. The

HAND GRENADES

PART SECTION OF VESSEL SHOWING ACID BOTTLE IN SUSPENDED CAGE

SPRINKLER

TYPES OF FIRE EXTINGUISHERS

details of the design vary somewhat with the different makers, and in one the acid bottle is so lightly sealed that the vessel merely needs inverting to produce the desired effect.

In small outbreaks even a soda-water siphon may prove sufficiently effectual, for it is really surprising what subduing power lies in the small stream of effervescing liquid.

Burning Oil, etc.

When dealing with blazing oil, fat, tar, or spirits, the above-mentioned appliances are not the most effective, as the application of much liquid tends to spread the area of conflagration rather than to subdue the outbreak. In such cases the use of dry powders is invaluable. The powder, however, may be used with equally good effect upon burning clothing, wood or fabric, and fire arising from gas leaks or fused electric wires, with a minimum amount of risk and damage.

The powder is supplied in long tubes, from which it is thrown, and a little dexterity is required for applying it in the most effectual manner, the idea being to spread it over the whole of the burning surface as quickly as possible. The powder must, however, be kept perfectly dry.

"Kyl Fyre," probably the most widely known of dry powder extinguishers, is capable of surprising results in the hands of cool and intelligent users.

Impromptu Fire Extinguishers.

When none of the above aids is at hand such other means as may be available must be at once seized to quell the outbreak before it attains unmanageable proportions. Blazing curtains may be beaten out with cloths, or even a folded newspaper if tackled promptly enough, or they may be torn down and trampled upon or smothered with a rug or carpet square. More formidable fires may be smothered with a wet blanket or carpet, or, if on the floor level, with wet earth, sand, or mortar; and burning liquids, fires arising from fusing of electric wires or gas leaks, by a liberal application of dry sand or earth, or, in the case of burning oils, smothered out with cloths.

Gas Escape.

In the case of escaping gas from a broken or fused compo pipe, the escape can be quickly controlled, if the pipe is exposed for any length, by beating the pipe flat at a respectable distance from the point of escape, thus closing the duct and cutting off the supply. To make quite sure, the pipe should eventually be doubled over an inch or two and hammered out again upon some hard surface such as a flat iron or large hammer-head.

When a fire is discovered in a room do not immediately open doors and windows to get rid of the smoke or to summon assistance, but

keep the room closed up as much as possible while dealing with the trouble or obtaining help.

Chimney Fires. A chimney on fire may be dealt with by throwing one or two generous handfuls of common salt or powdered sulphur into the grate, keeping the doors and windows closed and hanging a damp cloth or blanket over the fireplace to exclude air and to prevent the fumes of the salt or sulphur escaping into the room.

Fireproof Fabrics. To be prepared is, to a great extent, to be safe, and by due care many risks are to be avoided, but the chief aim should be to make the chances of an outbreak as small as possible.

Many inflammable fabrics used in decorating the home or for articles of clothing may be rendered perfectly safe, without in any way detracting from their appearance or shortening the life of the material, by the simple operation of rinsing them in a solution of salts, which will, at any rate, prevent them bursting into flames when brought too near a light or fire. After so treating, the material may be ironed and will appear in no way different from the untreated fabric. The solution is made as follows :—

Sulphate of ammonia	16 oz.
Carbonate of ammonia	2½ ,,
Boracic acid	3 ,,
Borax	1¾ ,,

Dissolve the above in 10 pints of water and when all traces of the salts have disappeared, add

Starch	2 oz.

Put the mixture over the fire and stir until it boils. Dip the material into the hot solution, wring out, and dry.

Another solution, which is used cold, but is not so good as the foregoing, is made up with :—

Tungstate of soda	16 oz.
Dissolved in cold water	1½ pints.

Then add :

Phosphate of soda	2¼ oz.
Dissolved in water	1 pint.

The latter mixture is largely used in fireproofing theatrical hangings, and scenery, and has been tested and approved by the Home Office.

Non-flammable wood for internal work may be obtained, if desired, and applied to all purposes in which wood is employed for decorative or utilitarian uses.

Section VII.—Lighting

CHAPTER XVI

GAS

"Here and there the lamps of evening glimmer,
Social watchfires
Answering one another in the darkness."—LONGFELLOW.

ARTIFICIAL light has grown to be a matter of no small importance in relation to home life since the natural duration of light became insufficient for man's purpose.

With the general advancement we have left far behind the comparatively primitive methods of thirty years ago, and the ever-increasing desire for still more light has called into being an army of specially trained engineers, whose business it is to satisfy the demand.

The principal sources of artificial light for home purposes, taking them in the order of their popularity, or rather their common use, are coal-gas, electricity, acetylene, and oil. Of these, coal-gas is by far the most extensively used, principally because the system is of earlier birth and has been more extensively exploited than any other means.

Coal-gas. Coal-gas is a complex mixture of gases in which hydrogen forms the greater proportion. It is evolved by the heating or destructive distillation of coal, and passes from retorts through various phases of purification to cleanse it of the many impurities which render the newly-made gas unfit for domestic use.

The service pipes are taken from the mains into the house in very much the same manner as the water-supply, but the service cock, instead of being situated outside the premises in the public thoroughfare, is placed just inside the house. The service is then attached to a meter, through which the whole of the consumed gas passes. The distribution of the gas throughout the house is usually arranged by carrying one principal pipe up through the house, from which branches are taken off at each floor, and these again throw out smaller branches to feed the various fittings.

These primary branches are generally placed beneath the floors or

behind skirting boards, and the secondary branches dropped down to the fittings in the rooms below.

Gas Pipes. All pipes, even to the smallest branches, should be of iron with screwed joints.

The lead composition pipe so often used accommodates itself more readily in fitting round bends and over moulding, etc., and consequently makes a cheaper job, but it is subject to so many chances of injury that its use should not be tolerated. Nails may be driven through it, it may be broken by frequent vibration, cracked or punctured by compression, or it may be gnawed through by rats or mice. In any case, a leak would probably be difficult to discover, and meantime a grave risk would exist of explosion and fire, to say nothing of the danger to health by inhalation of the escaping gas.

All gas pipes should, for this reason, be easy of access, and should never be built into walls, buried in plaster, or otherwise so stowed away as to be difficult to trace or to uncover in case of need.

Lighting efficiency is measured in candle-power, or, as technically expressed, "c.p. units," the unit being the light yielded by a spermaceti candle burning 120 grains per hour.

Burners. Coal-gas is fed through burners, which spread the escaping gas so that as large a luminous flame as possible is produced for the quantity of gas consumed. A variety of devices have been produced with this object in view, but until the introduction of the incandescent mantle the flat-flame burner held its own, and is still extensively used.

The flat-flame burner, which may be a "union jet," a "slit union," or a "bat's-wing," is made in various sizes capable of producing flames of from one to three candle-power per cubic foot of gas consumed.

The incandescent burner effects economy in a more perfect combustion of gas, and gives a greater efficiency in candle-power by reason of this and the increased area of luminous flame.

As a comparison, a No. 7 flat-flame burner, consuming 9 cubic feet of gas per hour, gives a light equal to 25½ candles, while a Welsbach "C" or "Bray" incandescent burner fixed on the same fitting and burning under the same conditions, consumes 4 cubic feet per hour and yields a light equal to at least 60 candles.

Allowance must, of course, be made for the cost of renewal of mantles and repairs and renewals to the more expensive burner; but, even if this should total up to an equal cost to the gas consumed by the flat-flame jet, we still have the much greater illuminating efficiency to the credit of the newer form.

Light Efficiency. Effective lighting depends largely upon the disposition of the burners, the colours of walls and ceilings, and, of course, the relative dimensions of the apartment.

For instance, an apartment with walls and ceiling of light colour would require less candle-power per 100 square feet of floor area than a room with walls decorated in sombre tints and a ceiling of dark oak, and a lofty hall would need a greater power than one of lower pitch, where the reflecting surface of the ceiling is much nearer to the floor. The practice but a few years back was to allow candle-power to the following extent for every 100 square feet of floor area :—

Cottage rooms	15 c.p.
Villa rooms	25 c.p.
Schoolrooms	30 c.p.
Large halls, specially well lighted	45 c.p.

But this is quite inadequate for latter-day requirements, and the following table may be taken as satisfying the present demand, subject, of course, to conditions, such as colour of walls, etc., being normal.

Dwelling-houses.	*Candle-power needed per 100 square feet of floor area.*
Reception-rooms	60 to 100
Dining-rooms	40 ,, 60
Bedrooms	15 ,, 25
Passages, etc.	10 ,, 20

Pressure. Gas is delivered into the mains at a pressure designated in tenths of an inch—that is, a force which will sustain a column of water so many tenth parts of an inch in height.

The average nominal pressure of delivery at the works is usually from twenty to thirty tenths. This pressure, however, varies with the demand upon the supply, and is, moreover, liable to fluctuations due to friction of the gas against the inner surface of mains and pipes and the difference in altitude above the works. As gas is lighter than the atmosphere, the pressure increases as the higher ground is approached, and is least on the lower ground. For the same reason, the pressure would be greater at the top of the house than on the ground floor, the rate of increase being one tenth to every ten feet rise.

The efficiency of a burner depends upon the pressure at which the gas is so delivered that complete combustion is obtained. Above or below that pressure means, in the one case, a waste of gas, and in the other an insufficient supply, but in either case there is a loss of lighting power.

A pressure of seven or eight tenths, which appears to be the most efficient for flat-flame burners, is not sufficient for the perfect lighting of an incandescent mantle. With the former, a large burner and a low pressure are the rule, but with the incandescent burner of the "C" and "Kern" type ten to fifteen tenths are required for economic use. Inverted incandescent burners need a pressure of twenty tenths or more.

The variation in pressure, which is again affected by the use of few or many lights fed from the house service, may be controlled by the use of a "governor," fitted in the service pipe close to the meter, which automatically regulates the supply and maintains a comparatively uniform pressure, whatever, in reason, may be the demand.

It should, however, be remembered that gas stoves and gas fires require a greater working pressure than flat-flame burners, and cannot always be fed effectively through a "governor" regulated for the light supply. For this and other reasons a separate pipe should always be carried from the meter expressly for stove supply.

Efficiency is affected by the size of the pipe feeding the burners, and it is not to be expected, however great the pressure, that a pipe of small bore will render the same service for a number of lights as one of a larger size. Yet this evident fact is often overlooked. A pipe $\frac{1}{8}$ inch in internal diameter is sufficient for one light and no more; a $\frac{1}{4}$-inch pipe will supply two lights, and so on; but it is inadvisable to use pipes of such small bore for any but short branches, as they are very liable to become choked.

Loss of Power.

Loss of power by friction has to be taken into account where the supply pipe to a number of burners is very long. Some idea of this is given in the table below, where the gas is assumed to be under pressure of seven tenths and the burners consuming 6 cubic feet per hour:—

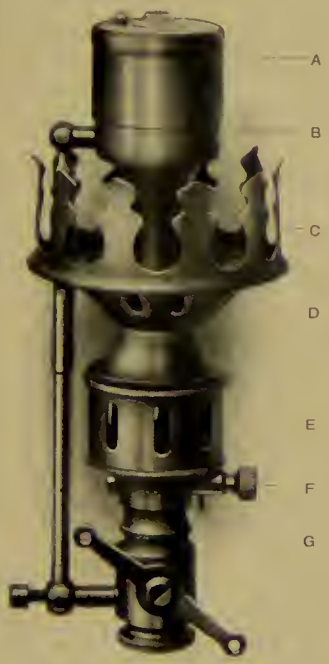
NUMBER OF BURNERS WHICH CAN BE SUPPLIED.

Internal Diameter of Pipe in Inches.	*Length of Pipe in Feet.*				*Internal Diameter of Pipe in Inches.*	*Length of Pipe in Feet.*			
	60	90	120	150		60	90	120	150
$\frac{1}{2}$	7	6	5	4	$1\frac{1}{4}$	52	47	37	33
$\frac{3}{4}$	17	14	12	10	$1\frac{1}{2}$	79	64	56	50
1	32	25	22	20	2	150	123	106	95

INVERTED BURNER

UPRIGHT MANTLE

INVERTED BURNER



"C" BURNER WITH BY-PASS

INVERTED MANTLE

A. Cap
B. Trumpet
C. Chimney-holder
D. Mixing-chamber
E. Burner-bottom with air-sleeve
F. Gas-adjuster plug
G. Adjuster-nipple

UPRIGHT BURNER WITHOUT BY-PASS

TYPES OF INCANDESCENT BURNERS AND MANTLES (BRAY'S)

An insufficient supply to fittings is sometimes occasioned by condensation of water in the pipes or accumulated rust and rubbish blown through by the gas until it is intercepted by an elbow or sharp turn in the pipe. The services of a gas-fitter will soon provide a remedy by the removal of the fitting or fittings, and blowing out the defective pipe.

Meters. Gas meters are constructed of different capacities or measuring powers and are supplied by the gas authority in size according to the number of lights for which they are required to do duty. The capacity in lights is marked on the front of each meter "5 lights," "20 lights," etc., indicating that the meter is capable of passing 6 cubic feet per hour for every light unit. The meter may be taxed to the extent of 25 per cent. above its total capacity, but no more, without loss of efficiency in lighting.

Incandescent Burners. The choice of burners is a matter of some moment, as even incandescent burners vary greatly in their efficiency. Taking the well-known types already mentioned, made by the Welsbach Company, for comparison, the "Kern," although a little more expensive than the "C," gives a 30 per cent. greater efficiency in candle-power owing to the gas being mixed more thoroughly and with a greater proportion of air. The inverted burner requires driving at a greater pressure in order to effect this mixture, and trouble often arises from the slowing of the air feed due to the heating of the mixing chamber, and a consequent loss in the completeness of combustion. This is shown by the sooting of the mantle. The latest types of inverted burners shield this chamber from the heat and provide a simple means of adjusting the gas feed to the available air-supply.

The following points in relation to incandescent burners should be carefully noted:—

Use the mantle sold expressly for the particular burner you use, as efficiency depends very much upon the shape and size of the mantle. This has been a matter of careful calculation and experiment on the part of the makers, and should, therefore, be worthy of notice.

Burners should be kept clean and free from dust inside and out, otherwise the feed of gas and air is disproportionate, and waste occurs. Most of the trouble with incandescent light is due to dirty burners. Many gas companies contract to maintain such burners, and it is economy to allow them to do so.

Regulate controlling tap of burner until the maximum incandescence is obtained. This may frequently be necessary, but the result will more than pay for the trouble involved.

A good type of incandescent burner is always fitted with an air-regulating valve immediately underneath an upright burner, and above the shield in an inverted burner. In addition to this, some are provided with a gas-regulating screw.

These means of adjustment are usually ignored by the average householder, and in consequence he does not get the best results from his fittings.

Frequent adjustment of this kind is necessitated by variation of pressure due to fluctuating demands upon the mains, alteration of pressure at the works—this usually is increased soon after sunset and decreased about midnight—and by other fluctuations, such as density or richness of gas, which it is difficult to account for.

The air regulator, therefore, should not be allowed to become set and immovable, as it frequently is, by disuse. Daily adjustment, at any rate, is necessary.

When the burner roars it indicates an excessive supply of air; and if the mantle tends to blacken, the supply of air is insufficient, and we get incomplete combustion and a diminished light.

There is more importance in the proper regulation of a burner than would appear from casual consideration, and economy is not the only resultant good from due care in this respect.

A nicely adjusted admixture of gas and air not only gives the maximum light for the minimum consumption of gas, but contributes far less poisonous products to the atmosphere of the room than a badly regulated burner.

This is one of the chief advantages of the incandescent system of lighting over the use of flat-flame burners, but one which is not generally recognised.

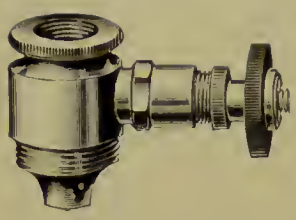
Gas-making Plant.

Country houses may be supplied by a small gas-producing plant, consisting of retort house, to which is attached stores for coal and lime, a condenser, purifiers, tar tank, and gas holder.

The retort house and store must be of substantial build, weather-proof, and well ventilated, but the remainder of the plant is placed in the open air.

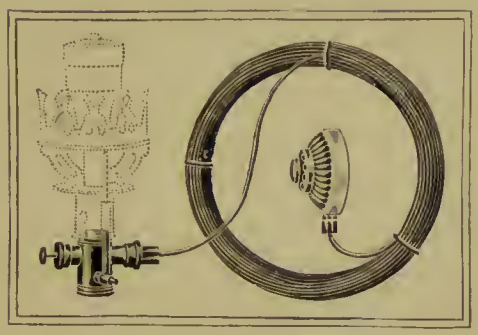
Further details of construction are not necessary, as size of plant and the mode of its erection is a subject for expert advice to meet the needs of each case. But it is said that gas may be produced at something like 2s. 6d. per 1,000 cubic feet, provided the coal is obtainable at anything like a reasonable price. One ton of coal produces, if properly handled, about 10,000 cubic feet of gas. Suitable

"C" BURNER (WELSBACH)



GAS REGULATOR FOR
INVERTED BURNER

GAS REGULATOR FOR
UPRIGHT BURNER



PNEUMATIC LIGHTING DEVICE

WELSBACH
"GEM" BURNER

PNEUMATIC SWITCHES

GAS-LIGHTING: DETAILS OF INCANDESCENT BURNERS AND LIGHTING DEVICE

coal must, of course, be used, and this, again, is a matter for the specialist, who would advise as to the most advantageous material to be obtained.

The by-products of manufacture may for the most part be utilised.

Tar as a preservative coating for wood and metal is too well known to require much explanation, and everyone is aware of its value as a treatment for roads and paths. For this, it should be boiled, and sprinkled whilst hot from a watering-can, brushed over in as thin a coating as possible, and immediately covered with a very thin sprinkling of dry sand or stone dust.

The ammonia liquor is a good weed killer for garden paths, but is apt to smell unpleasantly if applied during hot weather. Otherwise, this product may be poured away upon some waste piece of land, where it can do no harm to trees or other vegetation. The lime, when it has served its purpose in the purifiers, may be thinly applied to the land as a manure, and the coke is an asset which needs no suggestion for its useful application.

CHAPTER XVII

ELECTRIC LIGHTING

"The light of other days is faded."—BALFE.

IF electricity does not offer the cheapest, it undoubtedly affords the cleanest, safest, and most healthy light for domestic use.

Apart from the facility with which it may be turned on or off, its total freedom from fumes and gases, the by-products of combustion, and the small amount of generated heat, make it, all things considered, the most desirable.

The present limited use of this source of light, even in towns where the service is readily available, tends, as a matter of course, to keep up the price of the current; but, given a more general use, the economy of the system will undoubtedly assert its superiority for general lighting over all other systems now in vogue.

A certain shyness of this invisible force is perhaps caused by its peculiar attributes, and the mystery is increased by the employment of technical terms to denote very ordinary conditions, which have no etymological significance, and therefore convey no meaning to the uninitiated; but when these terms are understood the matter is not so difficult to comprehend.

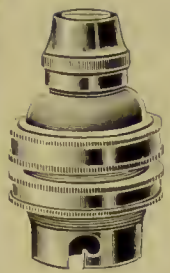
We have nothing to do at this particular stage with the production or generation, as it is termed, of the current. This is conveyed from the works into our dwellings in a manner somewhat similar to that of gas, except that the current in this case flows through a wire cable, circulates through the lamps, and returns to the works. In this respect it may be likened to a circulating steam-heating system in which the steam passes from the boiler and performs its duty as it travels through the outward part of the circuit, and returns in a more or less condensed form to the generator to be reconverted into heated steam.

Electrical Units.

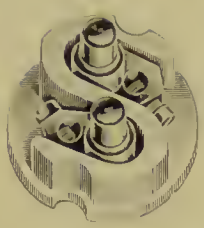
Gas, as we have noted, is supplied under a certain amount of pressure necessary to drive it through the pipes and to feed the burners. This force in electricity is called voltage. The unit of pressure is a volt.

Pipes of differing capacity are needed for conveying gas according

MAIN SWITCH AND MAIN FUSES

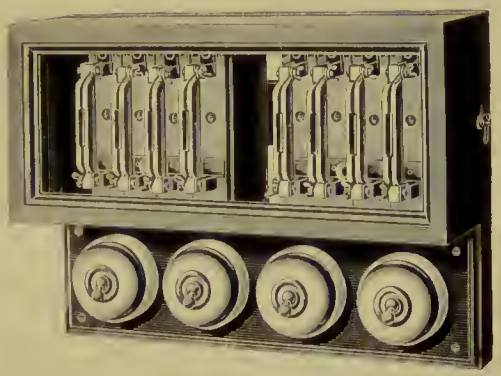


LAMP-HOLDER (ORDINARY) BAYONET GRIP

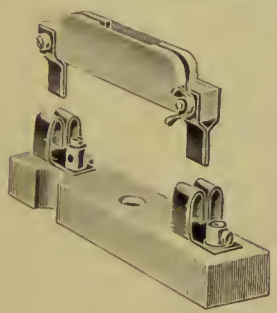


INTERIOR OF LAMP-HOLDER SHOWING SPRING CONTACT

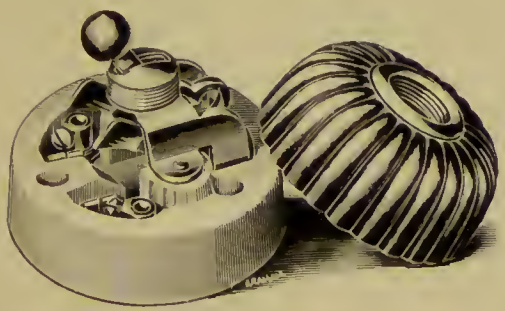
LAMP-HOLDER WITH SWITCH



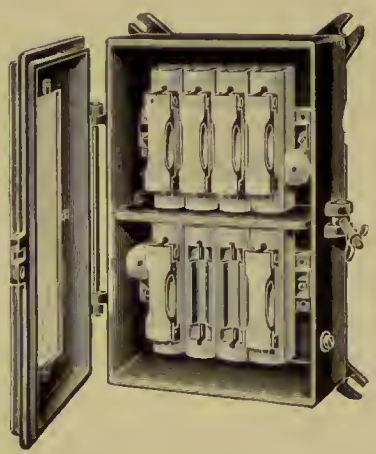
DISTRIBUTION BOARD WITH CIRCUIT SWITCHES



ENLARGED SKETCH OF PORCELAIN FUSE-HOLDER AND BASE



ORDINARY TYPE OF CIRCUIT SWITCH, COVER REMOVED



DISTRIBUTION OR CUT-OUT BOARD, FROM WHICH CIRCUITS OR BRANCH LINES ARE CARRIED

ELECTRIC LIGHTING: DETAILS OF WIRING

to the quantity consumed. The unit of capacity is, electrically, an ampere.

With gas we lose a certain amount of pressure or force by friction of the gas on the interior surfaces of the pipes. The electrical unit of such resistance is termed an ohm. A volt multiplied by an ampere produces a unit of quantity, a definite amount, analogous to cubic feet of gas. This unit of quantity is a watt. The registration by meter of the current consumed is in Board of Trade units, or, as shortly termed, units. A unit is 1,000 watt hours or one ampere at one volt pressure used for the space of 1,000 hours.

How the Current is Supplied.

The supply cable is composed of a number of separate wires bound round with insulating material arranged usually in concentric form. The inner core conveys the outgoing or positive current from the works, and the outer ring of wires carries the return or negative current. Sometimes there are two separate cables.

Current is supplied for domestic use at low pressure, that is from 100 to 250 volts. This may be broken down or converted into lower voltage for economic use by passing through a transformer, and used at 25, 50, 100, or 150 volts, according to the construction of the transformer. Immediately the cable enters the house the flow and return wires are attached to a main fuse, a species of safety valve designed to protect the domestic system from a too heavy and dangerous rush of current. This device, which is in a locked or sealed fireproof box, consists of the simple arrangement of two strips of soft lead wire, through which the flow and return currents pass. These wires are of such nicely calculated strength that an overdose of current causes them to melt, and the flow is instantly cut off. It is needless, perhaps, to point out that the fuse should never be touched by the consumer. New fuse wires may only be inserted by a competent electrician.

The cable passes from the main fuse to the meter, and from thence to the main switch, which is the turn-off cock controlling all the domestic supply. In modern practice this is generally situated in a convenient position beside a "distribution board." The distribution board is made of a non-metallic fireproof material, often of slate or porcelain ware, and at the back the cable from the main switch is divided up into as many portions as desirable for the required number of circuits. The ends of these portions are soldered into the sockets of the circuit fuse holders, which pass through the board and stand out on the face in the form of clips to receive the fuse holders. There

are two fuse wires to each circuit, one on the flow wire, one on the return, and these are again safety devices to prevent overloading the circuits.

Each circuit wire is carried from one fuse holder round the circuit of lamps and returned to the other fuse holder, thus completing the ring from distribution board to lamps and back to board again. The flow and return wires are heavily insulated and are laid either in dry wood casing, each in a separate groove or channel, or in metal tubes.

These two wires are kept apart as much as possible throughout the circuit, to obviate the chance of a short circuit or the passing of the current from one wire to the other. When this happens a great deal of heat is generated, the insulation burns off the wires, and the wood casing may take fire unless the circuit fuse gives way.

A Few Warnings.

Here, perhaps, a word might be said of the risks arising from ignorant or careless practices which are not uncommon. Instances are not wanting where blown fuses have been replaced with scraps of iron wire, hair-pins, even knitting-needles, and this often when the repeated blowing of the fuse should have warned the operator that danger was at hand.

The wood casing in which the circuit wires are carried is covered with a thin wood strip screwed or nailed into the casing. The casing thus presents a tempting fixing for picture nails and other purposes, and a short circuit between the two wires or leads enclosed is very possible when nails or screws are driven through it.

Circuit leads are usually covered with distinctive coloured material in order readily to distinguish the positive or flow from the negative or return lead—red or brown for positive, black for negative.

It should be remembered that all leads or cables must be protected from damp, and should therefore never be fixed upon damp walls, or in any position where the leads or casings can absorb moisture.

Improperly made joints of leads and branches are sources of great danger, and the householder should not be tempted to make extensions or additions to these unless he is in possession of expert knowledge and skill.

The circuits are broken in convenient positions for the insertion of switches to control the lights. Flexible leads used for pendant lights occasionally chafe through at the fitting, and a short circuit occurs, when the leads may be badly scorched; but little damage is likely to be done except to the leads, unless the burning insulation drops upon some highly inflammable substance. The insulation of flexible leads is liable to decay, when a short circuit may set fire to the

ELECTRIC LIGHTING

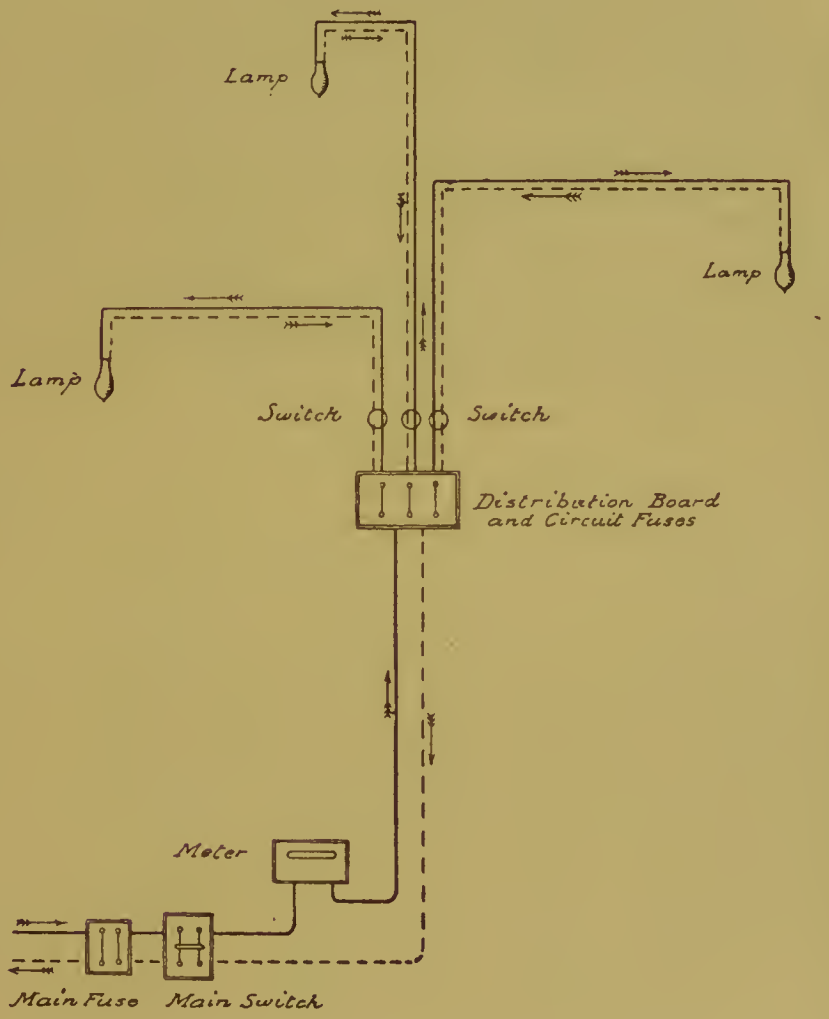


DIAGRAM ILLUSTRATING ORDINARY SYSTEM OF WIRING FOR HOUSE LIGHTING

insulation and, incidentally, to any inflammable material within reach. Such leads should, therefore, be renewed every five or six years.

The Lamps. The incandescent lamps or glow lamps in general use for domestic lighting may be roughly classified under two heads, the carbon filament and the metallic filament. Of the two there can be no doubt as to which is the more economical.

The carbon filament lamp is said to require 3.5, or $3\frac{1}{2}$, watts per candle-power, and the metallic filament lamp 1.7, or $1\frac{3}{4}$, watts per candle-power.

The recent improvements in the manufacture of the metallic filament lamps have brought them into great prominence; but still they require careful handling, as they are not nearly so hardy as the carbon lamps. The superiority of the metallic filament lies in its economic consumption of current and a more equable brilliancy throughout its life. As against this the initial cost of the lamp is from three to four times that of the carbon lamp, and additional care is required in storing and handling, but, despite these facts, the balance on the side of economy is still in favour of the metallic filament.

It is the reverse of economy to use a lamp after its brilliancy has perceptibly waned, for in this condition it requires an increasing amount of current the further it gets from the zenith of its incandescence.

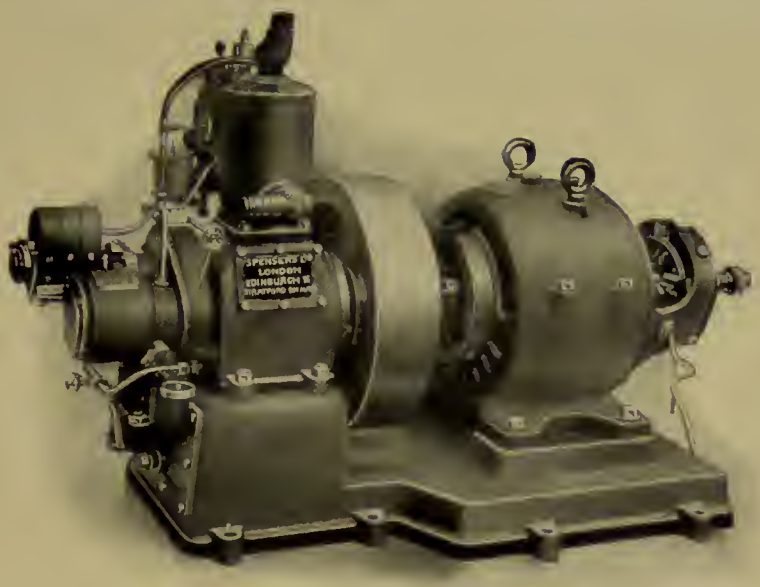
Home Generation of Current. A complete domestic electric light installation consists of engine, dynamo, and accumulators.

The engine, which is usually of the gas or oil type, is necessary to drive the dynamo or generator, and the accumulators are required to store the current as it is produced, so that light may be available at any time. Otherwise the running of engine and dynamo would be essential during the whole time the light is in use.

The whole plant, complete in every detail, can be obtained of reliable manufacturers, who will supply estimates and full particulars upon application. The size and power of the plant depends upon the number of lights required to be maintained, one light meaning a 16-candle-power lamp, using six-tenths of an ampere at 100 volts pressure.

The plant requires to be housed in a dry, well-constructed, and well-ventilated building in two apartments, the one accommodating the engine and dynamo, termed the generator house, and the other a small room for the accumulators or secondary batteries, and called the battery room.

Each room should have an independent door opening into the air, and there should be no communicating door between. The reason for



SPENSER'S DYNAMO AND OIL ENGINE

LEA AND WARREN'S GAS SUCTION ENGINE FOR DRIVING DYNAMO

ELECTRIC LIGHTING: GENERATING PLANT

this isolation is that the accumulators throw off a quantity of spray when charging up, and it is desirable that this should not be blown into the generator house, as it would be detrimental to the insulating material of the dynamo and other fittings.

Engine and dynamo must be fixed upon a substantial and immovable floor or bed, and it is usual to form this of Portland cement concrete.

The accumulators consist of a number of glass or vulcanite vessels of considerable size, in which pairs of cellular plates are immersed in diluted acid. Through these plates the current is delivered and storage to a definite degree takes place. The volume of current contained in one vessel depends upon the number of plates employed, but the total pressure resulting from each vessel is constant—viz., 2 volts.

The accumulators are arranged upon low slate shelves or in wood racks, and are stood upon insulated trays to avoid leakage of current.

Care is required in charging up and the general use of the batteries, and, although full instructions and rules are issued for working with the plant, the mention of a few essential points will not be out of place here.

When charging, the engine is started and the dynamo run up to its full speed with the switch open, or off, which connects the dynamo with the batteries. It should be seen that the battery cells are filled with the weak acid at least $\frac{1}{2}$ inch above the plates. Having the dynamo running properly, the switch should be closed, the voltage adjusted, as per instructions, to give the normal rate of charging, and the current run into the batteries until the liquid in each assumes a milky or lively gaseous state. When this appearance is attained, the cells are fully charged. It is as well to note the following easily remembered rules :—

The batteries should always be kept as fully charged as possible, and not allowed to run completely out. They should be charged up to the milky stage at least once a week, but the normal rate of charging or discharge should not be exceeded.

The dynamo must attain its full voltage before switching on to batteries.

The batteries should not stand long idle when very low in current.

The liquid in the vessels should be kept at normal height by the addition of soft or rain-water. More acid should not be added without expert advice.

Most manufacturers of accumulators contract to maintain the battery at an annual cost.

The battery-room floor should be paved with concrete or tiles.

With regard to the engine and dynamo :—

All parts should be kept clean and free from dust, oil, and moisture, and all bearings well, but not too abundantly, supplied with good oil used from copper feeders in preference to tin.

Bearings should not be allowed to wear and run loose.

The commutator must be kept bright and free from dust in any part, and the brushes should be so adjusted that no sparking occurs.

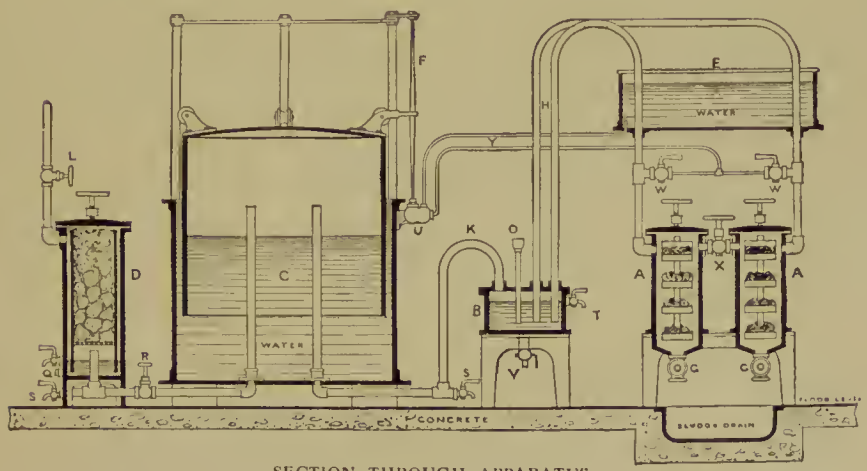
When the dynamo is belt-driven the belt should run tight on the lower side.

Start the engine slowly, adjust brushes, and gradually run up to full speed before switching on to batteries.

REFERENCE (see Section)

A. Generators
B. Washer
C. Gas-holder
D. Purifier
E. Water-feed tank.
F. Rod actuating Valve U
G. Sludge-valve
H. Gas-pipes from generator to washer
K. Gas-pipe from washer to gas-holder
V. Water-feed pipes to generators
U. Automatic valve governing water-feed

GENERAL VIEW OF APPARATUS



SECTION THROUGH APPARATUS

ACETYLENE LIGHTING: THE GENERATING PLANT

CHAPTER XVIII

ACETYLENE-GAS

" . . . Come, come;
Lend me a light."—SHAKESPEARE.

FOR small country houses in districts where gas and electric-light mains are unknown, acetylene-gas has some advantages which recommend it above other systems of lighting.

The necessary installation for producing the gas is less expensive, less bulky, and requires much less attention than a coal-gas plant or an electric-light installation.

It may, as a rule, be placed in any lightly built shed away from the house, and it is so simple that a quite unskilled person may attend it, provided certain simple and easily remembered rules are adhered to.

With regard to cost of the gas itself, this may be taken to come midway between the cost of coal-gas and electric current, or very little in excess of coal-gas lighting, for although the cost per 1,000 cubic feet of acetylene is about six times that of coal-gas the candle-power of the former is about four times greater as compared with incandescent gas. The intense white light given out by acetylene is not generally appreciated, but this may be tempered by the judicious use of screens and shades and the burning of the gas is remarkably free from by-products and considerably cleaner than coal-gas.

How the Gas is Produced.

Acetylene-gas is produced by treating calcium carbide, a chemical compound of lime and carbon, with water.

Calcium carbide is a grey, rock-like substance composed of 1 part lime to 2 parts carbon, and is represented by the chemical symbol CaC_2.

The substance greedily attracts moisture, and if left exposed to the air slakes down into a pasty mass by absorption of humidity from the atmosphere.

In this affinity for water lies the whole process of the production of acetylene.

When water (H_2O) is brought in contact with the carbide the oxygen (O) of the water immediately separates itself from the hydrogen and

combines with the lime of the carbide (Ca), forming a compound of lime, CaO, known as lime monoxide. This leaves the hydrogen (H_2) of the water and the carbon (C_2) from the carbide free to unite, and these are the component parts of acetylene (C_2H_2).

Fittings, etc. The gas has a characteristic odour of some pungency, and resembles that of garlic or onions. It has, moreover, a searching quality which necessitates the greatest care in the fixing of pipes and fittings, for, although copper appears to be the only metal upon which the gas acts chemically, the slightest imperfection in tubes or joints will be a point for escape. For this reason and the fact that much smaller conduits are needed for acetylene than for coal-gas, special pipes and fittings are supplied, with extra long joint screws and more carefully fitted cocks.

The dangers attending an escape of acetylene-gas are greater than with coal-gas, for, whereas 5 to 25 per cent. mixtures of coal-gas with air form explosive compounds, the range is much wider with acetylene—viz., from 3 to 82 per cent.

The Plant. An acetylene-gas plant consists of a generator, washer, and a telescopic gas holder. Sometimes a purifier is added, through which the gas passes from the holder to the house, and this is certainly to be recommended, as it greatly improves the quality of the gas.

As already mentioned, the plant may be housed in a well-ventilated shed, built away from the house; but, as the necessary stock of carbide needed for the effectual working of the plant cannot be kept without a licence, it is better to submit plans of the whole arrangement as proposed to the local authorities, in order that no subsequent trouble may arise when the application for a licence to store carbide is made. Usually, however, a wooden shed on brick foundations is allowed.

There are several reliable firms who make and supply automatic acetylene apparatus, and, although each make differs in some respects with regard to the arrangement of parts and details of construction, one of the two modes described below is usually employed. In the one the carbide is automatically lowered into the water as the gas-holder falls, owing to consumption of gas, and this recommences generation and lifts the carbide clear of the water and suspends the operation as the holder rises by gas pressure.

The other method works by gas pressure in the generating chambers at the side of the holder, which admits a supply of water to the carbide chamber when the pressure falls in the holder, and automatically drives back the water when the pressure rises.

BURNERS OF THE BATSWING TYPE

BURNER OF CANDLE FLAME TYPE

BURNERS OF HORSESHOE TYPE

HORSESHOE ATMOSPHERIC BURNER

ACETYLENE LIGHTING: VARIOUS FORMS OF BURNERS

In a modified form of the above the carbide is water-fed by a lever cock, the lever being actuated by the rising and falling of the gas holder. Hand-fed apparatus suitable for more extensive lighting is also made.

Recharging the generator should be as simple as possible, whatever the type, and the generator should have no complicated mechanical arrangement, which is liable to get out of order.

The carbide store and generator house must be well ventilated and perfectly dry, and should be kept locked, except when recharging, etc., is necessary.

The generator must never be attended to at night when the use of an artificial light is required to carry out the operation, and on no account may the attendant enter the house with a lighted pipe, cigarette, or cigar, as it is quite possible for the escaping gas to take fire from glowing tobacco.

No inflammable material may be kept in the generator house, and it must be at a safe distance from any fire or other source of light.

Means should be provided for the escape into the open air of an overcharge of gas, should the plant by careless attendance produce an excessive amount. The gas holder should be of simple construction, and no mechanical parts should be concealed therein. Its water seal should be kept regularly filled, and nothing should be carried or placed upon the bell, or a fluctuation of gas pressure will result.

Burners. The necessary pressure under which the gas is delivered depends upon the size of burners used, and varies from 2 inches to 4 inches. The burner generally used, consuming ½ cubic foot per hour, requires a pressure of 2½ inches. As with coal-gas the size of pipe required to feed the burners varies with the distance the gas is carried and the number of burners served by the pipe. The following table gives the ratio of internal diameter of pipe to length and number of burners supplied :—

Size of Pipe in Inches.	*Length of Pipe from Generator or from Main Pipe in Feet.*	*Number of Burners Consuming ½ Cubic Foot per Hour.*
⅛	15	2
¼	30	5
⅜	40	10
½	50	20
¾	100	50
1	130	70

A burner consuming ½ cubic foot of acetylene-gas per hour gives a light of from 18 to 25 candle-power.

Burners of an especial design are necessary for use with acetylene, and these are made on the twin principle, in which the two streams of gas are directed inward and meet at the point of ignition. The orifice of the jet is very tiny, and combustion is assisted by means of an air-supply which is drawn in through small holes at the base of the jet.

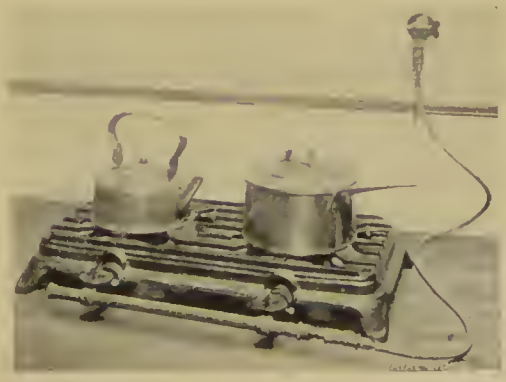
Water-slide or telescopic pendants are quite unsuitable for acetylene lighting on account of the inadequacy of the water seal and the difficulty of making a satisfactory sliding-joint which shall be proof against gas leaks.

STORAGE BINS FOR CARBIDE OF CALCIUM

ACETYLENE GEYSER

ACETYLENE RADIATOR

ACETYLENE LIGHT FITTING WITH CANDLE-FLAME BURNERS



ACETYLENE COOKER

CHAPTER XIX

OIL AND VAPOUR GAS

"Beneath each lamp that through its lattice gleams,
Their fancy paints the friends that trim the beams."
—BYRON ("The Corsair," Cant. III and XVIII)

OIL is the chief source of artificial light in many country homes, and a brief consideration of the various phases of the system deserves a place.

The popular method of using this illuminant is by means of lamps of more or less common form, in which the oil is fed through a cotton wick suspended in the reservoir from a burner by means of which the flame is regulated.

The mineral oils so largely used for this purpose are of petroleum origin, and are variously known as paraffin, kerosene, or petroleum, or perhaps more widely recognised by the brand name under which they are sold, as "Homelight," "Daylight," "Sunlight," etc.

Dangers of Oil Lamps.

Much has been written and said of the dangers of the oil lamp, but risks are common to the use of all artificial light, and arise principally from the source of most mis-adventures—namely, ignorance and carelessness.

The cheap and badly constructed lamp is, of course, responsible for some danger, but the number of accidents arising from lamp explosions are comparatively small as compared with those arising from careless handling.

Points to be Noted.

Oil lamps should have a stout metal reservoir, with a sufficiently long tube leading to the burner to avoid undue heating of the oil vessel. The burner should screw well into the oil vessel and have an ample air feed, without which complete combustion is impossible. The burner should also have an easily manipulated lever attachment for instantaneous extinguishing, to avoid the necessity of turning the wick down or blowing out the light.

Well-fitting and easy-working wick should be used. Special wicks may be obtained for all good makes of lamps. A good quality oil should be burned—this is economy in the long run—and none but

well-fitting and substantial lamp-stands, brackets or hangings should be used.

The burner, air intake, reservoir, and wick should be kept in a clean condition. Occasionally the drum or can in which the stock of oil is kept should be cleaned out, as all such oil precipitates a certain amount of slime or mud.

The lamp should not be over-filled, for if the oil is full up it will creep over the edge of the reservoir. It should not be forgotten that when the wick is put back the oil will rise by the amount displaced by the wick and tube. Lamps which are not intended for hand use should not be carried about the house.

An intelligent observation of the above points will leave little chance of misadventure, and, apart from the somewhat troublesome task of daily refilling and trimming, a satisfactory light can be obtained which is said to compare favourably in point of cost per candle-power with gas lighting, having one paramount advantage in its favour, that little fumes or gases are produced by combustion.

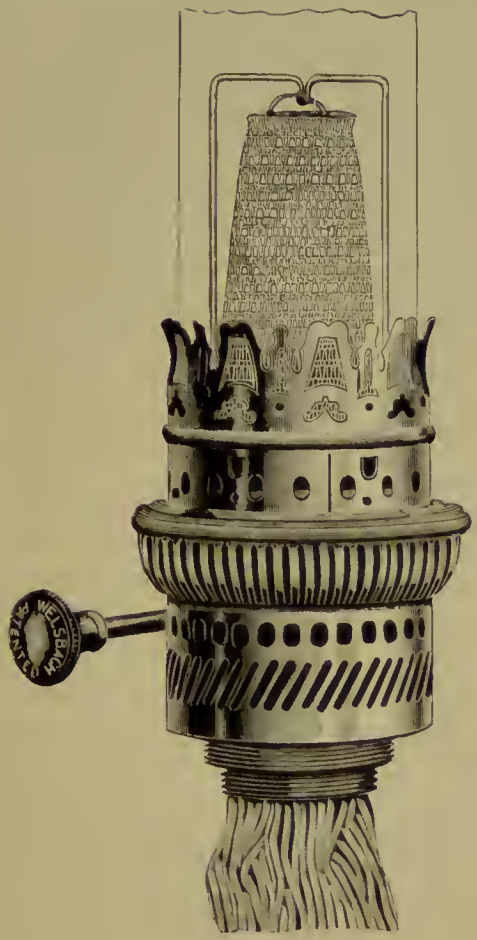
The use of incandescent mantles for paraffin lamps has hitherto been retarded by the high price of the special burner and by the additional care needed in trimming and general use owing to the delicate nature of the mantle. The burner is also said to be noisy and difficult to regulate.

Vapour-gas. Vapour-gas, or air-gas, is made by passing a current of air over the surface of petrol, which evaporates at very low temperatures, producing an intimate mixture of vapour and air consisting of from 1½ per cent. to 6 per cent. spirit vapour, which yields a soft, brilliant light, not to be approached, it is said, by any other artificial light for pleasing qualities.

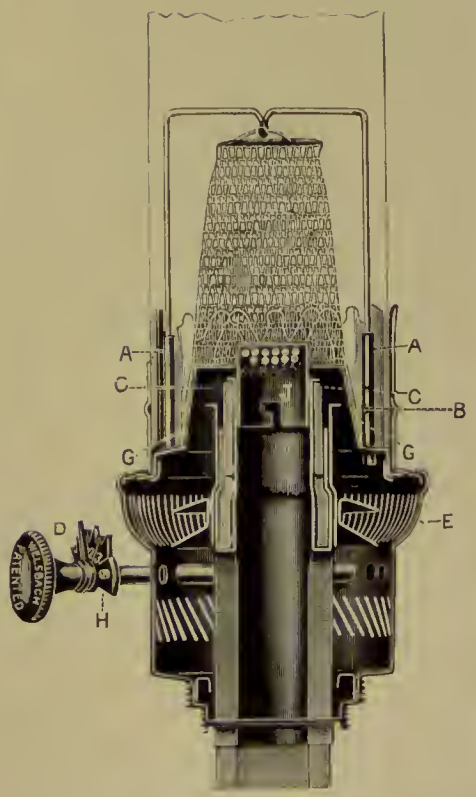
The gas is used through incandescent burners of special make and of small size, and the cost is said to be about 1s. 6d. per 1,000 cubic feet, with oil at 1s. per gallon.

But such statements as this are most misleading, as the illuminating power of a cubic foot of all gases is not the same, and even samples of the same kind of gas vary with the class or grade of raw material used and the method of production. This gas is largely used in America, both for lighting and cooking, but has found little favour in this country so far, owing possibly to the unscientific construction of much of the plant placed upon the market.

The system has some disadvantages which one would not expect to be trumpeted forth by the manufacturer of the plant, and the chief of these appear to be due to the variable nature of the



A. Mantle support
B. Mantle
C. Wick
D-H. Wick regulator
E. Air feed
G. Burner cone
J. Central draught tube



SECTION OF BURNER

OIL LIGHTING: THE WELSBACH INCANDESCENT BURNER

oil and the fluctuation of evaporation due to temperature, which makes it difficult to maintain the quality of the gas. There is also the fact that some severe accidents have resulted from careless keeping and handling of the spirit and the use of improper plant. The system has, in consequence, been labelled "dangerous," which disposes of the whole matter so far as the greater part of an indiscriminating public is concerned.

The question, however, does deserve a second consideration, as the merits claimed for this method of lighting would certainly place it far above other systems as an inexpensive and hygienic light.

"Safety-gas," as it is termed by one prominent firm, is said to be secure from any possibility of explosion, and there is no danger of asphyxiation.

The plant needs little attention, and occupies but little space. Products of combustion are few, chiefly water. There are no sulphurous fumes or other products inimical to plant life, no smell, and no blackening of ceilings. There is no corrosion of pipes or fittings and no condensation in the pipes.

The gas is equally adaptable for lighting or cooking, and is particularly suitable for incandescent lighting, as the mantles last longer and retain their maximum brilliancy for a greater period than with coal-gas.

Two prominent systems for the production of this gas are the "Safety-light" and "Vapour-gas."

The plant generally consists of oil reservoir, carburettor, gas holder, and a device for inducing a current of air.

In the "Vapour-gas" plant a small hot-air engine, driven by the gas generated, works a fan to produce the necessary air movement, and the whole plant is most compactly fitted upon an iron stand which occupies but little space.

The "Safety-light" plant may be driven by a water-motor or actuated by a weight-driven drum.

This system, which is worked under the De Laitte and Elwell-Smith patents, is reported to produce a gas of very even quality, and the working of the plant is automatic and easily understood. Briefly, the details of arrangement are as follows:—The water-driven plant consists of four cylindrical vessels: No. 1 is the purifier, No. 2 the carburettor, No. 3 the motor and compressor, No. 4 the gas holder.

The whole process of generation is worked by the motor.

Air is drawn through the purifier over calcium chloride to dry it,

and passes into the carburettor, where it is thoroughly mixed with the vapour of measured and automatically delivered quantities of petrol periodically fed in at the top of the carburettor.

The mixture of air and vapour is passed through to the gas holder by the compressor.

Attached to the top of the holder bell is a lever, which cuts off the water-supply to the motor as the holder fills, and immediately the motor stops the process of air-supply and petrol also ceases.

When the bell of the holder falls the motor starts again and the various parts resume their functions.

The weight-driven plant is similarly controlled by a brake acting on the winding drum. The latter plant has to be periodically wound up.

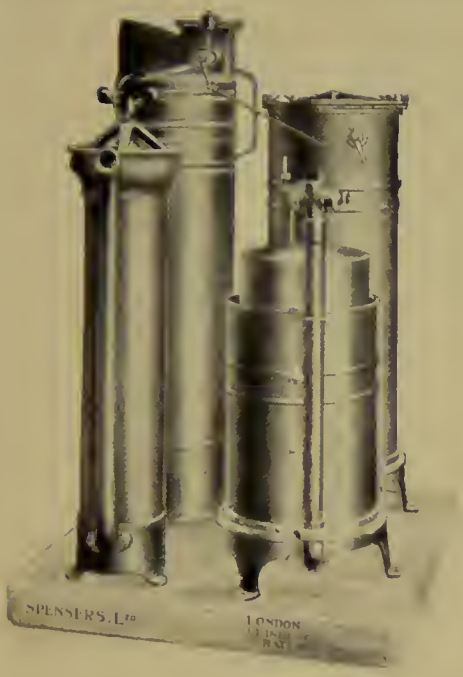
Some care is, of course, needed in recharging the petrol tank, but if the plant is placed in a cool, well-ventilated shed and the necessary work carried out in daylight, all risk should be avoided. It is also well to remember that long after a tank or tin is exhausted of its liquid contents there still remains a quantity of explosive vapour which is not to be trifled with.

Explosive mixtures of petrol, vapour, and air vary from 2 per cent. to 5 per cent. of vapour, and there is some controversy as to the particular mixture which it is desirable to store and convey through the pipes to the burners.

Petrol requires an admixture of something like 95 per cent. to 98 per cent. of air for complete combustion. Some plants, as "Safety-gas" and "Vapour-gas," produce and store the poorer mixture, and safeguard the danger of a back-flash by special burners and other devices, while other makers, as the County Lighting Company, prefer to produce a richer gas and supply the additional air required in burning by the use of a Bunsen burner, thus avoiding the storage of an explosive mixture. The champions of each system have their own weighty reasons to put forth for the particular methods employed, and one is forced to conclude that petrol lighting, however advantageous and hygienic, is not exactly a simple matter, and that expert advice in the choice of plant is absolutely necessary.

For the storage of any quantity of petrol special arrangements must be made, and the local inspector of explosives should be consulted as to his requirements, but even small quantities are best stored in a cool place out of doors.

Incandescent lamps, as made by the Petrolite Company, find much



WATER-DRIVEN PETROL-GAS GENERATING PLANT

THE PETROLITE LAMP BURNER-TUBE

THE PETROLITE LAMP CONTAINER, WITH PATENT ABSORBENT STONE

PETROLITE TABLE LAMP

PETROL-GAS BREAKFAST COOKER

TYPES OF BURNERS FOR AIR-GAS (BRAY'S)

favour in some houses and are perfectly safe if the makers' instructions are carried out. The use of spirit of a guaranteed quality is necessary to obtain an even light, and some attention must be paid to the form and adjustment of the mantle.

Oil-gas is also obtained by the distillation of oil in specially constructed retorts and the heating of oil-shale, but as this is wide of our present purpose the matter need not be further considered.

CHAPTER XX

BELLS

" I'll make so bold to call,
For 'tis my limited service."—SHAKESPEARE.

THE general convenience of the home is greatly furthered by a good service of bells or some such means of quick communication from room to room; but the system, whatever it may be, should be simple, direct, and easily accessible for repairs and adjustment in all its parts. Mechanical bells will be considered by many people to be very much out of date, but they offer certain advantages over their more modern rivals which still recommend their use. Not the least of these advantages consists of their extreme simplicity and certainty of action.

Mechanical Bells.

A sudden failure of any part of the system does not occur without a lengthy warning, and if quite ordinary care is taken repairs are seldom required.

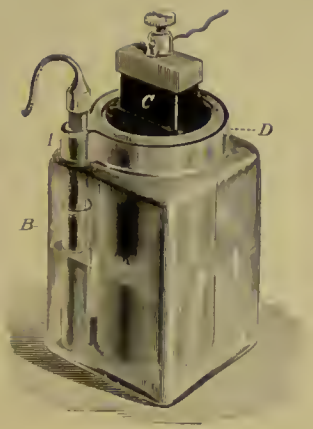
The disadvantages are the clumsy appearance and noisy action of wires and pulls, and the seeming impossibility of obtaining really well-made and reliable fittings. Moreover, the system is unsuitable for large installations.

In fitting such bells it is desirable to negotiate as few angles as possible, and for this reason experts recommend that all wires should be carried from the pull up one tube to the top of the house and down another tube to the bell.

Galvanised iron tubes with screwed joints should be used, as the ordinary zinc tube is liable to split and jamb the wire. All angles should be negotiated with a wheel and chain, and wires should be kept reasonably tight.

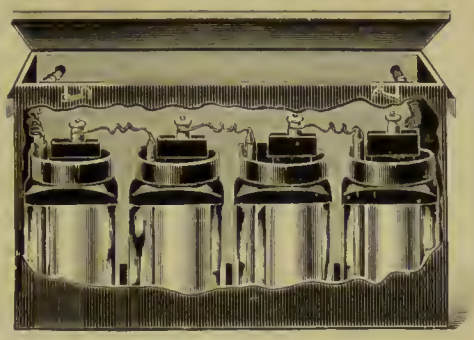
The wire recommended for the purpose is of copper, 16 gauge for indoors and 14 gauge outdoors.

The bells usually provided are so nearly all of one tone that indicators are needed to determine which has been rung. If each bell has a distinctive note much unnecessary trouble may be avoided.



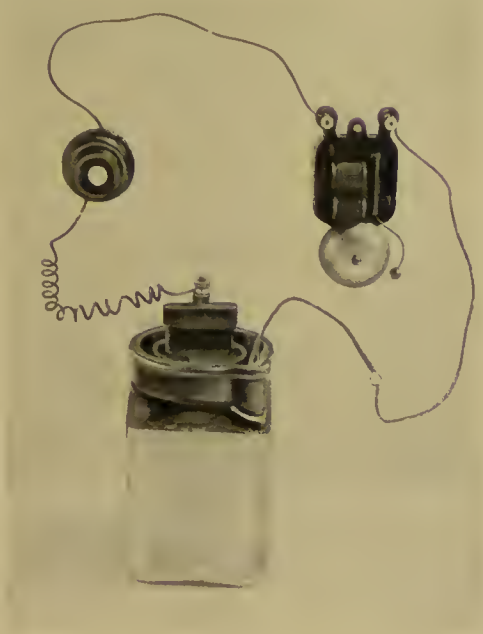
LECLANCHÉ CELL

A. Zinc rod (Positive Element)
B. Sal-ammoniac solution
C. Carbon plate (Negative Element)
D. Porous pot with mixture of manganese dioxide and carbon



BATTERY OF LECLANCHE CELLS

DRY CELL

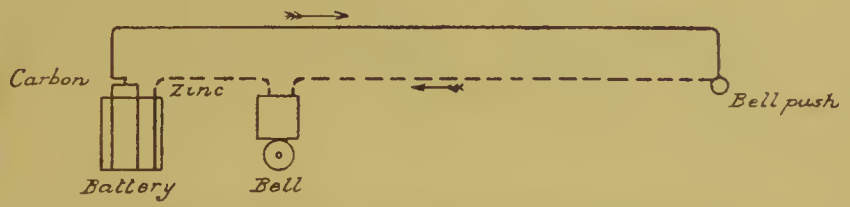


THE "CIRCUIT" OF AN ELECTRIC BELL

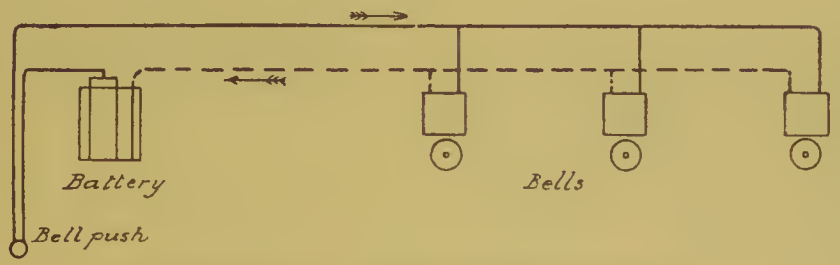
ACCUMULATOR OR STORAGE BATTERY

BELLS

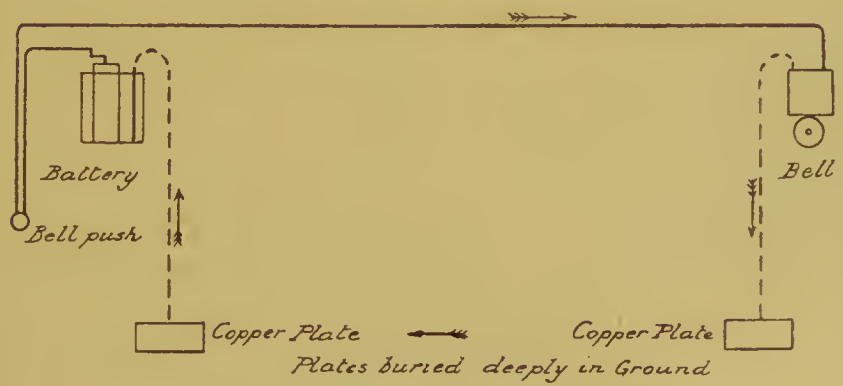
DIAGRAMS OF ELECTRIC BELL CIRCUITS



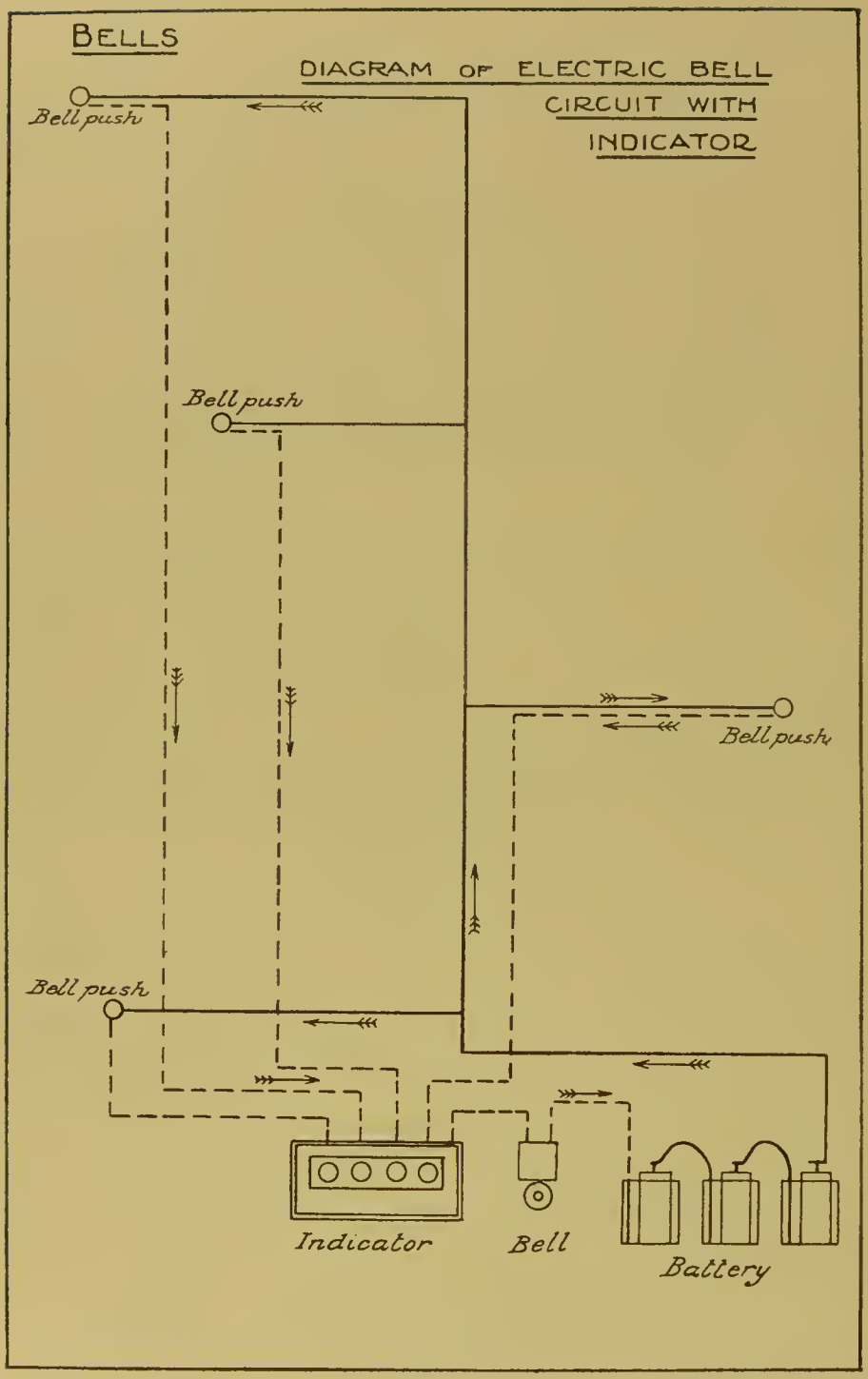
SIMPLE BELL CIRCUIT SHOWING HOW BATTERY AND BELL MUST BE CONNECTED



CIRCUIT WITH THREE BELLS RUNG FROM ONE PUSH.

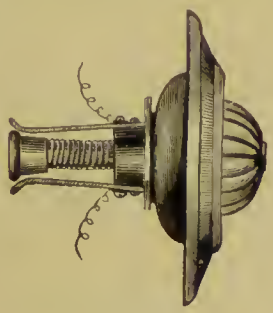


LONG DISTANCE BELL CIRCUIT WITH EARTH RETURN

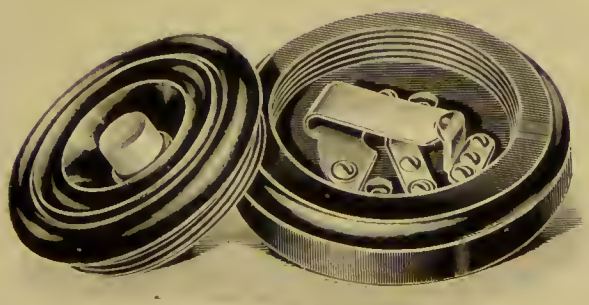

BELLS
DIAGRAM OF ELECTRIC BELL CIRCUIT WITH INDICATOR
Bell push
Bell push
Bell push
Bell push
Indicator
Bell
Battery

PENDULUM INDICATOR. STAR OF ANY PARTICULAR CIRCUIT SWINGS WHEN BELL IS RUNG

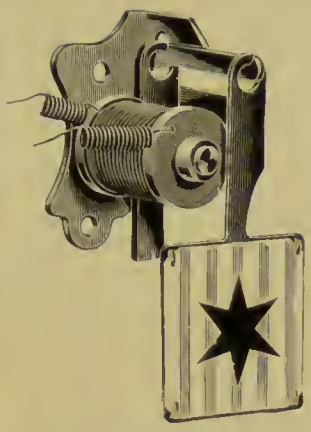
MECHANICAL REPLACEMENT INDICATOR. NUMBER DROPS WHEN BELL RINGS AND REMAINS DOWN UNTIL REPLACED



ELECTRIC BELL PULL

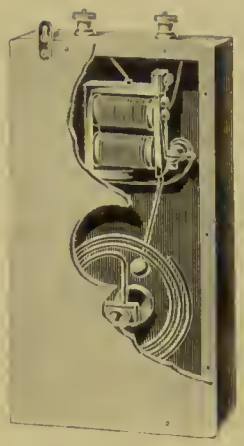


ELECTRIC BELL PUSH, COVER REMOVED



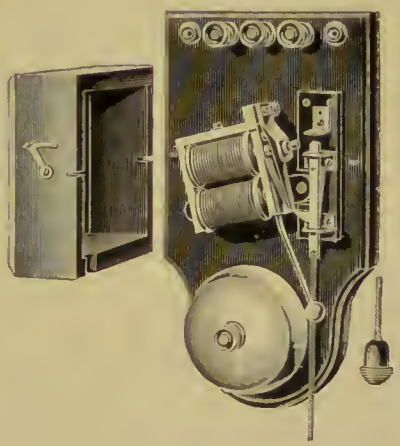
ENLARGED VIEW OF ACTION

ENLARGED VIEW OF ACTION



ENCLOSED BELL OR GONG

ELECTRIC BELL SWITCH



ELECTRIC CONTINUOUS RINGING BELL, SHOWING DETAILS OF CONSTRUCTION. HANDLE AT SIDE IS PULLED TO STOP RINGING

ELECTRIC BELLS: DETAILS OF FITTINGS

Pneumatic Bells. Pneumatic bells are much neater in appearance than the foregoing, quiet in working, inexpensive to maintain, and simple in construction. They are worked by a push or pull, which compresses a hollow rubber ball and drives a current of air through a small pipe to a bellows arrangement actuating the mechanism of the bell and indicator.

The communicating pipes are of very small bore, $\frac{1}{32}$ inch to $\frac{1}{8}$ inch in diameter, and they may be taken round angles which would offer real difficulties in the fitting of mechanical bells; and they may be fixed in positions exposed to damp, where electrical fitting would be impossible. The india-rubber push balls and bellows to bells are really the only parts liable to destruction, and these, it is said, should have a life of from four to five years.

Bells may be single-stroke or trembling bells, similar to those used for electrical fittings. The system is not satisfactory for long distances, but under conditions when it is impossible or inadvisable to carry electric wires the pneumatic system may be used in conjunction with the electrical fittings, by a simple bulb arrangement at the far end of the pneumatic tube, which shall receive the transmitted pressure and make an electric contact in the bell circuit.

Electric Bells. Electric bells are now in very common use, and the facility with which they are fitted serves to make them first favourites; but there are certain disadvantages which weigh heavily against their adoption, the chief of which is their liability to sudden breakdown owing to running down of the batteries, faulty contacts, and short circuits.

Electric bells may be run by wet or dry batteries or by accumulators, but the objection to the latter is the electromotive force of the current used and some consequent slight risk of fire and additional chance of short circuits; but it is only where a large number of bells are employed that it is considered necessary to use such an amount of energy.

The cheapest and most suitable battery for the purpose is a wet one formed of Leclanché cells, but their bulkiness and liability to damage and upsetting has led to the use of the neater and more stowable dry cell. Care is required in connecting up the cells of the battery that a proper circuit is obtained by connecting the positive terminal of one cell to the negative of the next in regular succession, and that the ends of the wires are perfectly bare and bright and firmly gripped by the terminal screws.

All wires must be well covered with insulating material and should

not be exposed to steam or reek, nor be fixed in otherwise damp situations. All joints should be thoroughly made by scraping or filing up the ends to be joined, twisting them firmly together and soldering. Finally, cover the joint with a firm binding of rubber tape.

Where there is more than one push connected with the bell, an indicator is necessary. This is a box with a glazed, painted front, upon the face of which are the names or numbers of the rooms, and under each a clear-glass circle, behind which a printed disk either oscillates or falls when the bell from that particular room is rung.

A choice may be made of a single-stroke, trembling, or continuous-ringing bell. The ordinary trembling bell continues to ring all the time the push is held in contact, but the continuous bell remains in action until switched off. The latter is used more particularly in burglar alarms, fire alarms, for arousing servants, and for doctors' night bells.

Buzzers or sounders may be attached to bell pushes, which indicate by a slight buzzing noise when the bell is in action. If the bell does not ring, the buzzer is also silent.

An electric-bell installation may be made more useful by the attachment of a simple form of telephone called the "Metaphone," and a more useful means of communication established between dining-room and kitchen, or bedrooms and servants' room.

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